The Electrical World.

VOL. XXIV. NEW YORK, DECEMBER 8, 1894. No. 23.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,
in the U. S., Canada or Mexico; other Postal Union countries, $6.

In requesting your address changed give OLD as well as new address.

Established 20 years ago, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the Largest Circulation of any electrical periodical in the world, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXIV. NEW YORK, DECEMBER 8, 1894. No. 23.

CONTENTS.

Editorial 587
The Bate Refrigerator Case 588
Electrical Differences of Potential 589
Typical Inventors 589
Suggestions for Buffalo's Electrical Carnival, by Frank C. Perkins . 590
Wire Losses, Over-Compounding of Dynamos and Regulation of P. D. in Multiple Arc Circuits, by E. P. Roberts 592
Transformer Testing, by Eustace Oxley 593
Mathematic and—Mathematics 593
The Successful Application of Electricity to the Operation of Mines, by W. F. C. Hasson 594
Currents and Lines of Force, by B. S. Lampher 595
Notes on the Management of Railway Power Stations—IX., by George F. Hanchett 596
Electrodynamic Machinery—XVIII., by E. J. Houston and A. E. Kennelly 597
Practical Notes on Dynamo Calculation—XX., by A. E. Wiener . . 598
The Architect and the Electrical Engineer, by Keppele Hall . . . 600
Symbols and Abbreviations, by E. J. Houston and A. E. Kennelly . 601
Fly-Wheel Accidents in Power Houses, by A. H. Burnett 601
Digest of Current Technical Electrical Literature, compiled by Carl Hering 602
New Book 604
A New Car Controller 604
Electric Clocks 604
Mileage of Electric Railways in Europe 604

DEPARTMENTS:

Financial Intelligence 605
Special Correspondence 606
News of the Week 607
Trade and Industrial Notes 609
Business Notes 609
Illustrated Record of Electrical Patents 610

ELECTRICAL ENERGY DIRECT FROM COAL.

Heat is a very good thing in its place but very objectionable when out of place; it is not surprising therefore that while some engineers are trying to get as much heat out of coal as possible others are trying equally hard, if not harder, to get as little heat as possible. A few weeks ago we called special attention to some recent interesting develoments in one of the two problems of the day, the production of light without unnecessary heat, and in the present issue some interesting figures and suggestions are given in an article abstracted in the Digest regarding the other of the two problems of the day, the production of electricity from coal also without unnecessary heat. The possibilities in the former are that from 20 to perhaps 250 times as much light may be obtained per watt than at present, the figures differing with different authorities, one giving even a very much greater possible increase; the possibilities in the other problem are known more definitely and show that we can obtain nine or ten times as much electrical energy from coal as at present obtained by what are called good steam engines or boilers, good in construction but very poor in principle. If both of these limits are reached, the results will certainly be startling, but at the same time they should not be overestimated. There are three factors in the cost of light, the fuel, the labor and the capital, the first of which is smaller than is often supposed; assuming that the other two are not increased or diminished by a very much more efficient method of generating electrical energy from coal or light from electrical enegry, or both, then the effect of such an improvement on the cost of light will be but small. Unless, therefore, such improvements also diminish the cost of labor and capital per candle-power hour, they will be chiefly of scientific rather than of practical interest, at least as long as coal is cheap. The experiment alluded to above showed an efficiency which is already three or four times better than that obtained by the steam engine. A curious feature in the production of electric energy directly from coal, is the possibility of obtaining even more than 100 per cent. on a somewhat similar principle as that suggested in an interesting and classic paper by Lord Kelvin,—then Prof. Thomson—read before the Physical Society of Glasgow in 1852, namely, by obtaining in addition some of the energy residing in the heat of the surrounding air, which heat costs absolutely nothing. We have several times called attention to a battery constructed on this principle, which shows that it is possible to convert the heat of the air directly into electrical energy. There are a number of ways in which the problem of obtaining electrical energy from coal can be attacked, some direct and some indirect, and although owners of central stations and purchasers of electrical plants need not have any fear that the present machinery will soon be useless, yet from the attention given this subject at present it is not at all unlikely that some results of practical value will be reached before many years; they need be only very poor to exceed those obtained by the steam engine.

ANOTHER ELECTRICAL THEORY.

We have frequently referred in these columns to the quantities of pseudo-theories with which the public is favored through the non-scientific press, and which has resulted in bringing the word "theory" into popular distavor. A recent and amusing instance of one of these is from the pen of a writer who approvingly quotes the opinion of a friend to the effect that he posseses a genius for physical research and should spread the light of his undesrtanding abroad, who intimates to the reader that his grasp of first principles is intuitive, and informs them that until four years ago he had no knowledge of mechanics

of any sort and had given no attention whatever to science. With this introduction we will permit our theorist to proceed. "It is my "belief that sooner or later some naturally gifted man will conceive "and understand the natural power and will be able to transmit "electrical effects from the earth's currents into the uinversal vac- "uum, and thereby communicate with other spheres—at any rate "facts instead of theories will be known of this great natural power. "How is it possible for those to reproduce or direct a complete power, "when, as I notice in a pamphlet describing an electric motor, they "say that 'the elements employed in the cell are zinc, from which "the negative current is obtained, and the positive current from "black oxide of copper.' Copper is not positive, nor is zinc negative "but just the contrary. Copper is a negative material and zinc is a "positive material matter, which means that copper as a material "matter influences and adheres to say 90 per cent negative (fem- "inine) current and probably loses 10 per cent. of the positive "(masculine) current, thus being a negative material matter (fem- "inine), or a gentle or softer metal. Zinc as a material matter "influences and adheres to say 90 per cent. posiitve (masculine) "current and probably 10 per cent. negative (feminine) current; "thus certainly it is a positive (masculine) or a sterner or harder "metal; in the same manner as with mankind and animals."

THE NATIONAL SCHOOL OF ELECTRICITY.

The numerous inquiries we have received from readers in regard to the National School of Electricity, seem to indicate that those in charge have not been eminently successful in imparting a clear understanding of the methods and object of that enterprise. The misconception that prevails we believe to be largely due to the ambiguity that exists as to the real function of the so-called faculty; to the implied claim that philanthropy forms the basis of the undertaking, and to a lack of definition of its object; a frank statement on these points from the managers of the school would go far towards relieving it from the suspicion that seems now to exist in some quarters as to its real character. We believe that a useful purpose may be accomplished by a system of elementary instruction organized somewhat after the lines of the Chautauqua course, with the addition of a more practical element for the benefit of those engaged in electrical pursuits who have not had the advantage of instruction in electrical principles. The interest displayed in the University extension courses conducted this spring in New York under the auspices of Columbia College, and in the several similar electrical courses now running in New York and Brooklyn, show that there exists a lively desire to gain electrical knowledge, and we believe that in every city and town where there are a sufficient number connected with electrical pursuits a similar interest exists that might be usefully catered to. We do not consider, however, that such a course of instruction can accomplish much more than to teach the elementary principles and the broad outlines of electrical science. It may impart the general knowledge that amateurs and others desire, and teach those engaged in electrical callings the points of theory they lack, and whose acquisition will give them a firmer grasp in dealing with their everyday work; but it will not make electricians and engineers, though the vague promises contained in the circular of the school in question may be construed into a claim to this effect. We are not aware that any direct claim of philanthropy has been made by the managers of the National School of Electricity, but, judging from newspaper clippings, some of its agents have conveyed this impression, which has an apparent basis in the undoubted disinterested motives of the auxiliary "faculty." If the object is a philanthropic one, a direct statement to that effect should be made, accompanied with an explanation of the disposition of the considerable sums of money which would accrue if the school were as successful as designed. If, on the other hand, the enterprise is a purely commercial one we cannot see why this should not be frankly avowed, for there would be no discredit attached that we can see. Another explanation due to those who are asked to subscribe to the course is the real function of the "faculty." It has been stated, without contradiction that we know of, that two members of this body have repudiated, as far as refers to them, the statement that the "faculty" takes an active part in the preparation of the courses; and we note that the lesson sheets have no signatures. As the managers of the school, as far as we are aware, do not claim any reputation either as electrical engineers or as teachers, the reputation of the other members of the "faculty" is that upon which success depends, and it is simply a matter of fair dealing to give assurance that the confidence which may have been thus inspired is not misplaced. If the points to which we have referred are satisfactorily cleared up, and the school is conducted in the straightforward and open manner which we feel sure is the earnest desire of the highly respected gentlemen whose names have been its stock in trade, it may accomplish a very useful purpose even if it does not extend to the making of electricians and engineers. Under its present management, if satisfactory assurances can be obtained that all the courses and lesson sheets have been prepared by members of the "faculty," and if the local instructor is a competent man, we see no reason why the advantages thus offered should not be accepted by those who desire to obtain general ideas on electrical science, or who wish to supplement their practical experience with a knowledge of the simpler points of electrical theory.

The Bate Refrigerator Case.

Through the courtesy of Charles L. Sturtevant, Esq., of the Washington patent bar, we are enabled to present a resume of the closing argument in the Bate Refrigerator case. Mr. Carter, who was the last counsel heard, went especially into the interpretation of the statute based upon the report of the Committee of the Congress which passed the law at issue. He laid great stress upon the fact that the duty of the House Committee on Patents in that Congress was merely to report to the House a revision of the patent laws as they existed at that time, and contended that, while it was a bill to amend as well as to revise, they distinguished between what was technical revision and consolidation and what was amendment, and informed Congress that both they (the revisors) and the general committtee on revision vouched for the revision as an accurate reproduction of the existing law without change. He particularly called the court's attention to the fact that Mr. Jenckes. a very able patent lawyer of his time, and Chairman of the Committee on Patents, stated that it was not necessary to read the bill in full, but that the House might safely confine its attention to the features and passages which were pointed out by the printed document as amendments. He quoted from the report of the Committee on Patents, and his argument was a very elaborate and forcible one, to show that Sec. 8 of the statute of 1836, and Sec. 6 of the statute of 1839, define the class of patents which came within their scope by the application dates, and that the statute of 1870 and revised statute 4887 must refer only to inventions patented abroad before the filing of the application in this country; for the report of the Committee on Patents on the Sec. 25 of the Act of 1870 is specifically to the effect that it is a revised but a substantial reproduction of the law under the Acts of 1836 and 1839.

By way of illustrating the harm that could and does result from giving to the present statute the interpretation hitherto adopted by the Circuit Courts, he referred to provisions of Sec. 4915 which allow the unsuccessful applicant for a patent to seek protection by a bill in equity, and contended that the defendant's reading is specifically inconsistent with the course authorized by this section, for although after a long course of action the court under Sec. 4915 might grant the patent and decide that the Commissioner was wrong in not allowing it in the first instance, the time required to invoke these remedies has in law destroyed the right where the foreign patent has been applied for, and thus in effect sanctioned the wrong. Mr. Carter also referred to the practice in case of interferences, where, beside the great delay, an interference requires a disclosure to the adversary, by printed depositions, of the whole invention, while the opposing party by sending a few copies abroad can prevent foreign patents, or if they have been previously applied for he can prolong the case here until the foreign patents have come out and so curtail the American patent.

Mathematics According to a Mathematician.

Dr. Oliver Heaviside says that the best result of mathematics is to be able to do without it.

Electrical Difference of Potential—An Analogy.

BY JOHN WADDELL.

Electrical difference of potential is in many respects analogous to difference of pressure of air, and reasoning which applies in the case of the latter, is sometimes illustrative with regard to the former. Among the different methods for establishing difference of electrical potenial, is that, which is now so important commercially, the movement of a conductor across a magnetic field of force. Exactly how the electrical condition is produced by the field of force is of course unknown; but as an illustrative analogy the following has been found useful. It will naturally be borne in mind by the reader that he is dealing with an analogy merely. Suppose a box, which for the sake of definiteness, we shall assume to be twelve inches long, and half an inch in width and in depth, air tight and filled with air, to be fitted inside with an indefinitely large number of little paddles which can swing backwards and forwards in such a manner that if set in motion in one particular direction, they will propel the air (by its scooping motion, let us say) towards one end of the box, and if set in motion in the opposite direction, they will propel the air to the other end of the box; while if they are brought to rest, the air assumes and retains a uniform pressure throughout the box. We may conceive that when the box remains quiet, the paddles do not move and even that bodily movement of the box in *certain* directions, does not disturb their position, but that movement in *certain other* direction causes such oscilliations of the paddles as to produce difference of air pressure. To attain this end, a mechanism such as the following might be imagined.

Let there be two boardss, placed vertical and opposite to each other, separated by a little distance (a few inches say), suppose from the center of each square inch of the one board, a steel wire stretched straight across to the opposite board. There would thus be rows of wires running from board to board, the number of vertical and horizontal rows depending upon the width and height of the boards. With the dimensions we have adopted, it is evident that the box could be placed so as to lie horizontally between the rows of wires, and without touching them. We may assume that the box is placed with its length at right angles to the direction of the wires. Let us now consider the paddles in the box so connected with the outside, that friction across the box in one direction would give one particular movement to the paddles; while if the direction of the friction were reversed, so would likewise be the movement of the paddles. We can conceive as a means of obtaining the friction, that the steel wires are cut across, but that the ends are kept together by the elasticity of the wires, except when they are pushed asunder. If the box is moved from above downwards, causing the wires to bend and separate so as to permit its passage, friction is obtained and the paddle will be set to work in such a manner as to propel the air from *left to right* let us say. So soon as the box passes through, the wires spring back into position, and appear continuous from board to board.

Now let the box return along its path, moving consequently from below upwards; the reversal of the movement of the mechanism will propel the air from *right to left.* Any motion of the box by which the steel wires are not disturbed will produce no motion of the paddles, and, therefore, no difference of air pressure. Such for example is the case with motion in a horizontal plane between the wires. A little thought will show the reader that if the box were turned with its length vertical, motion from left to right would propel the air from above downwards, and vice versa.

In this analogy it will be readily understood that the box represents an electric conductor such as a copper bar or wire; the boards represent magnetic poles; and the steel wires magnetic lines of force, which if cut across by the conductor, cause the establishment between its ends of a difference of potential. Any motion of a copper bar in the field of force, by which the lines of force are *not* cut, produces no difference of potential in it, just as any motion of the box by which the steel wires were undisturbed, produced no difference of air pressure. Moreover, the number of lines of force cut in a given time, determines the amount of difference of potential, and the *direction* of the motion across the lines of force, determines at *which end* of the copper bar the potential will be the higher; just as in the analogous case with the air pressure. If the spectator is looking from the north pole, along the lines of force, towards the conductor, its motion will produce difference of potential *in the same sense* as was assumed for the difference of pressure in the case considered above.

Again, if the conductor cuts, not perpendicularly, but oliquely across the field of force, fewer lines will be cut, and the same thing would hold for the box, hence, in the one case, the difference of potential, in the other, the difference of pressure, between the ends, would be diminished, and in both cases according to the *cosine* law. Furthermore, if the box were longer than the width of the series of rows of wire, for instance, if the boards were only nine inches wide in the case considered above, part of its length would contribute nothing towards developing difference of pressure. So if a conducter is longer than is required to cut all the lines of force, part of its length is useless. On the other hand if there are rows of wires uncut by the box, they are valueless, and in the same manner, if there are lines of force uncut by the conductor they are wasted. These items are important in the construction of dynamos; in economical machines the endeavor is made to have as little useless wire as possible, and also to have the field of force as nearly as possible confined to the space within which the armature rotates.

As in order to move the box against the friction of the steel wires energy must be expended, so work is required to move a conductor *across* the field of force, although motion by which the lines are uncut, requires no expenditure of work.

The analogy can be followed out, in the case of motors as well as of dynamos, for it will be easily seen that, if the paddles in the box are moving, and if they are within reach of the steel wires, the box will be dragged across the space between the boards, in the direction *opposite* to that in which it would need to be moved, in order to give that particular movement to the paddles. So it is, when a conductor in which an electric current is passing, is placed free to move, in a field of force, and this reversal of motion is the underlying principle of motors. As was said at the beginning, we have been dealing with an analogy only; but the speculative may interest themselves in considering whether lines of force may not be due to some strain of the ethereal medium, similar to what would be produced by a line of particles, rotating on an axis, whose direction is that of the lines of force. In that case an electric conductor might be considered as a body, whose molecules, or their constituent atoms, might have imparted to them a peculiar motion when the conductor breaks through the medium in its strained condition; or, if the dielectric be considered as the seat of electrical phenomena, a conductor might be regarded as such an interruption in it as would permit the establishment, by the same means, of some peculiar condition at its boundary.

Typical Inventors.

Mr. Alexander Siemens in a recent address said that when he came to England in 1867 he made the acquaintance of one of his workmen, whose business it was to lacquer brass work, and who had the peculiarity of coming to his work only long enough to earn sufficient to keep him from starving; the rest of his time he devoted to the construction of a machine for generating power. He had been a lawyer in good standing in one of the minor German states; but, unluckily for him, he had a "mechanical turn of mind," which induced him to give up his practice and to come over to England, where he hoped to realize a fortune from his invention. In 1867 he assured Mr. Siemens that another fortnight's work would complete the machine, and a new era would commence in the world's history. In spite of all arguments, of all ridicule, and of all the disappointments met, he continued working at this machine until he died about two years ago without being any nearer to his goal than he was twenty years ago. Mr. Siemens read as follows, a letter received from another inventor:—"I am not a madman—I am not an inventor nor am I a mechanic—but I have been thrown amongst engines, stationary, locomotive and marine, a great deal. A simple accident has revealed to me the modus operandi by which steam can be generated with any degree of power and employed in the propulsion of vessels without the cumbrous details of boiler or steam chest, etc. I do not go to some capitalist who may rob me of the thought —nor some other who would wish to clap me into an asylum as a dangerous lunatic—but to practical engineers like yourselves, who can, if my idea is the mere dream of a fool, instantly annihilate it with practical objections. If you will permit me to call upon you, five minutes is all I want, if I cannot satisfy you that I have not wasted your time, I will submit to be kicked out of your premises."

A New Physical Journal.

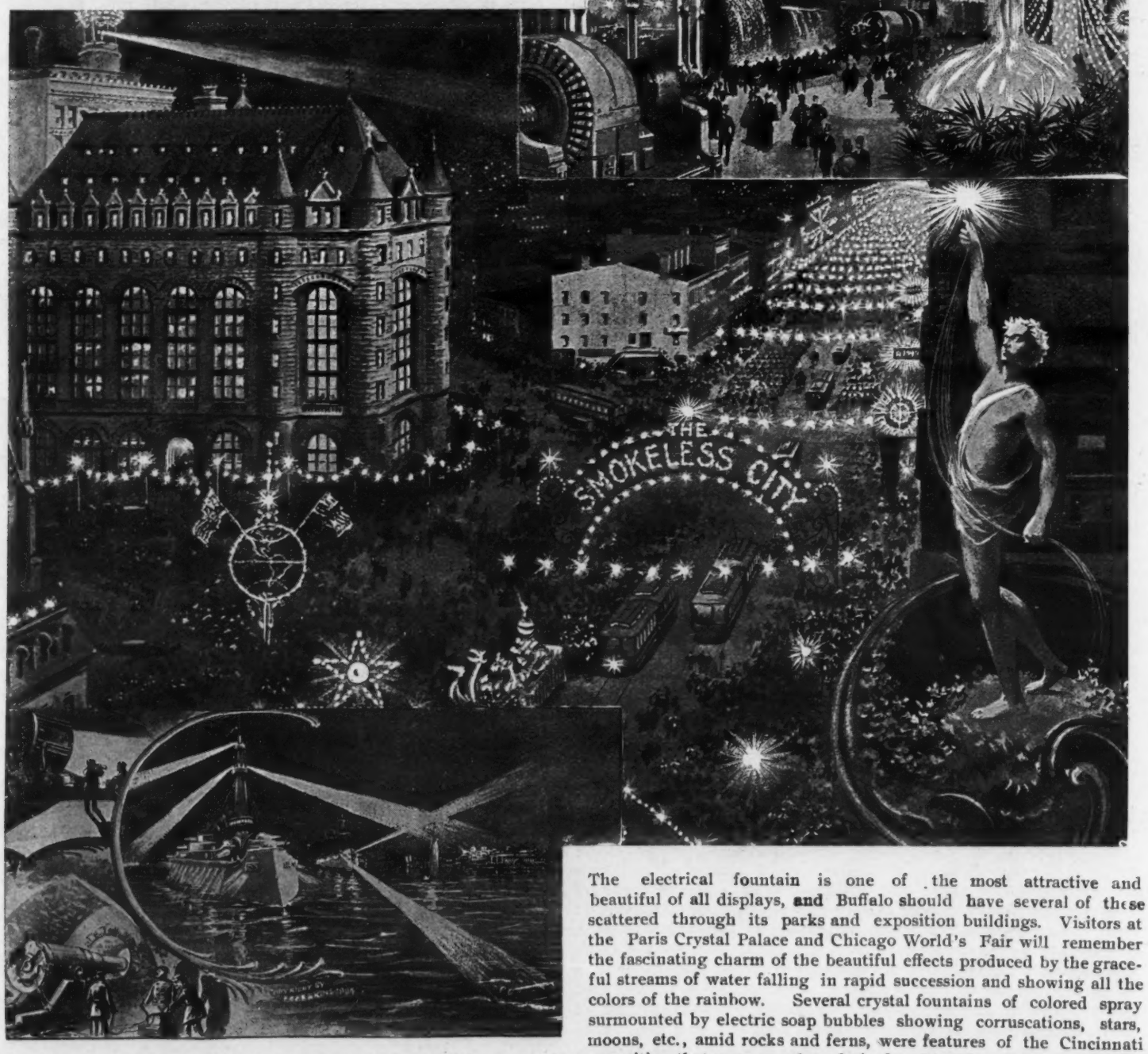
According to London *Electricity*, Nov. 16, a new physical journal devoted to the subject of physics is to be started at the beginning of next year, with the well known electrical writer, Mr. James Swinburne, as its editor.

Suggestions for Buffalo's Electrical Carnival.

BY FRANK C. PERKINS.

It is hardly possible to imagine a grander sight than Buffalo might present during the coming electrical carnival—a celebration that will mark the beginning of a wonderful increase in population, wealth and industry for the electric city. Few people realize what the limits of greater Buffalo may be in the near future and the growth and advancement the city is to experience through the development and transmission of electric power from Niagara Falls. The celebration of itself cannot, therefore, be made too grand and extensive.

Manufacturers will have an opportunity to show all classes of apparatus capable of being operated by electrical energy, and every electrical attraction worthy of note should be secured and magnificent electrical displays arranged for the exposition grounds. As the whole city will undoubtedly be brilliantly illuminated and numerous novelties and electric attractions scattered throughout the city,



the interest will therefore not be confined to the exposition grounds but the character of the celebration will be that of an electrical carnival in every sense of the word, instead of a mere electrical exposition. As indicated in the large illustration, business blocks will be beautifully decorated with brilliant electric lights, search lights will flash their rays from observation towers on many of the high buildings, and as the city authorities will probably co-operate with the street railway companies, the streets will be a blaze of glory.

Numerous festoons of series of five or ten incandescent lamps crossing the streets between the trolley wires and the iron poles which support them could be fed through current from trolley wire clamps and make a fine display. The exteriors of trolley cars might be trimmed with colored lights and produce a wonderfully pleasing effect. Many of the excursion steamers and other boats having electric plants can be brought into play and have illuminating festoons of lamps on their decks, and illuminated fleets on special evenings would make an attractive spectacle and give an object lesson as to the great extent electricity is being utilized aboard ship.

The electrical fountain is one of the most attractive and beautiful of all displays, and Buffalo should have several of these scattered through its parks and exposition buildings. Visitors at the Paris Crystal Palace and Chicago World's Fair will remember the fascinating charm of the beautiful effects produced by the graceful streams of water falling in rapid succession and showing all the colors of the rainbow. Several crystal fountains of colored spray surmounted by electric soap bubbles showing corruscations, stars, moons, etc., amid rocks and ferns, were features of the Cincinnati exposition that were greatly admired. Electric gardens, and magnificently illuminated flower beds, electric owls with flashing eyes of fire, magic Japanese fish, a mysterious electric fountain suspended by a single wire flashing jets of water high into the air, were some of the sources of great wonder to visitors at the Horticultural building, and Buffalo's display should not be exceeded by any of these.

The electric scenic theatre exhibited at Chicago should be reproduced and thus delight thousands who were unable to attend the

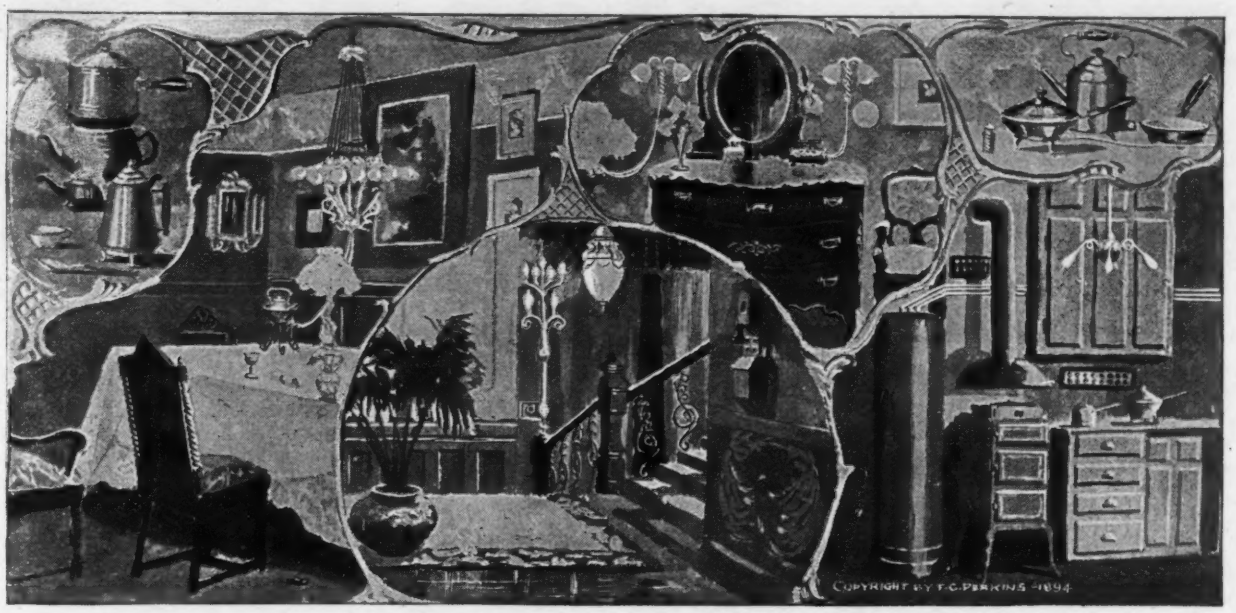
World's Fair. An entirely new design, similar, for example, to that shown in the accompanying illustration could be made. Arrangements could also be made to take visitors behind the scenes and show them how the changes are produced; the means of accomplishing the wonderfully realistic effects would prove to many not less interesting that the effects themselves.

An electrical cascade as near a miniature Niagara as possible should be made, with thousands of gallons of water falling over electric fire, appearing and disappearing in colors of the rainbow and with flashes of lightning. The water should be pumped by electric pumps operated by power transformed at Niagara and a double transformation thus made—the falling water at Niagara transformed into power, then into electrical energy, and after being transmitted over 20 miles of wire, retransformed to power pumping water over the miniature Niagara.

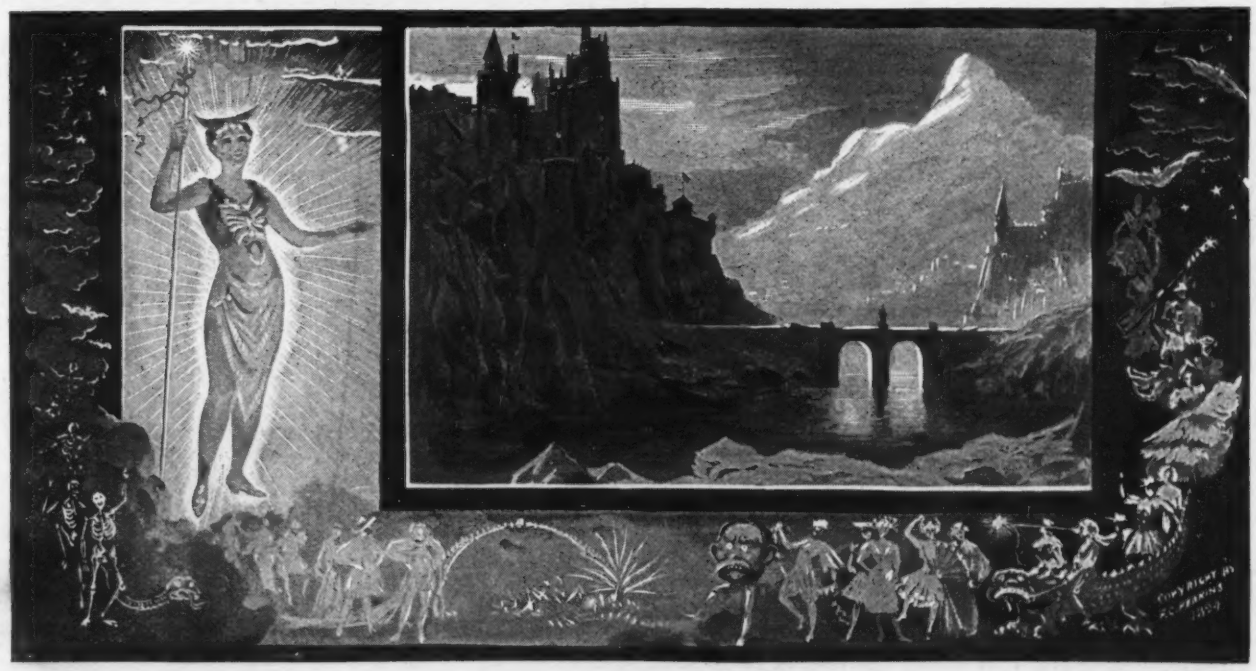
The use of electricity has been steadily increasing in New York and Chicago theatres for several years, and something wonderful in this respect should be secured for Buffalo during the carnival.

The Buffalo electrical night procession can easily be made to surpass anything ever done in that line. Floats can be mounted on trucks drawn with horses or by electromotors, simply using trolley car trucks and motors, the current to be fed from the trolley wires for both the illumination and propulsion of the floats.

Some enterprising furniture and decorating establishment should make an exhibition covering the many uses to which electricity can be applied in the household, including a display of the artistic effects possible in decorating rooms. The accompanying illustration shows some of the possibilities of Buffalo homes of the near future. Ceiling and panel lights are now being brought into use, lamps are automatically turned on by opening doors, curling irons, shaving cups and other articles are electrically heated. Five o'clock tea in parlor or sitting room, at which, by means of a simple button or switch, heat may be supplied and tea made or chafing dishes heated; electric dish washers, electric cigar lighters in the smoking room and even electric boot polishers; electrical pianos that play selections from several hundred pieces; ventilators, dumb waiters, elevators operated by electric motors, as well as coffee grinders, silver ware buffers, and laundry and ironing machines; these are but a few of the appliances that might be shown and which will be within the reach of the household in Buffalo through the utilization of Niagara's power, and whose final realization the electrical carnival should fitly inaugurate.



ELECTRICITY IN THE HOUSEHOLD.



THE ELECTRICAL SCENIC THEATRE.

Wire Losses, Over-Compounding of Dynamos, and Regulation of P. D. in Multiple Arc Circuits.

BY E. P. ROBERTS.

PRELIMINARY NOTE.—Since writing that which follows this paragraph, Prof. Crocker's criticism has appeared. That which Prof. Crocker states is certainly correct, although the writer is inclined to think that he puts somewhat too much stress on the omission, in the article of Oct. 13th, to state that the equalizer bar method was successful in practice after having made the statement that it is correct in theory. From the standpoint of the criticism the point is well taken. The article was intended to deal with errors in a practice which is daily followed by engineers in good standing, and the degree to which the error is injurious, and it was not intended to deal with other methods, though, in the light of Prof. Crocker's criticism, the facts which he states could wisely have been incorporated, and the writer advises that such be done by the reader.

It was an unexpected pleasure to the writer to find that his note entitled "Relation between Line Wire Losses and the Over-Com pounding of Dynamos," published in the Electrical World, Oct. 13th, was considered worthy of an editorial notice, and also to find it considered by the *Engineering Magazine;* and, in addition, to receive a number of personal inquiries relative to the subject. The "raison d'etre" of this article is that both personal and editorial criticisms and comments have led the writer to believe that the

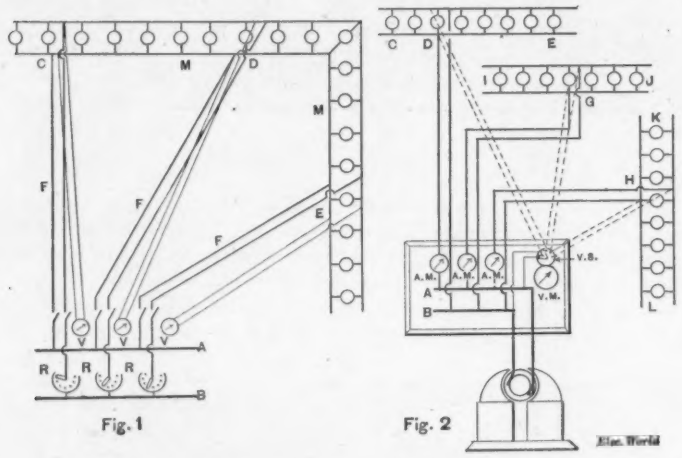


Fig. 1 Fig. 2

DIAGRAM OF CIRCUITS.

following notes may be of assistance to those who have not studied the maintenance of constant P. D. at the translating devices of a Multiple Arc Circuit.

An article by the writer of this paper was printed in The Electrical World of March 3d, showing various systems of wiring for M. A. circuits, and their comparative advantages as far as even distribution is concerned. The usual system for a plant for general distribution is, as shown in Fig. 1 of this article, and for isolated plants, either as in Figures 1 or 2.

First. Let us consider the inherent weakness of the system shown in Fig. 2, taking only one branch circuit, and, for convenience sake, considering that we can obtain a wire to give just the line drop indicated at full load. If it be decided to lose four volts from A to D and return, and one volt between C and D, and also between D and E, and not over 100 volts is to be allowed at when D at full load and 20 amp. flow across at C and at D and E we will have at C and E 99 V. and the R. of D to C and of D to E. .05 and of A. D. B.—.06⅔ and the V. A. at A. B. 104 V. If the P. D. at A. B. be constant, the condition of greatest rise of P. D. at the translating devices is when the load is lightest and if .5 amp. only be used and be taken off at D., and then at P. D. at D. rises to 103.97. This is the one extreme case, and how nearly it will be reached, depends upon the *conditions of the case and the care and skill of the designer.* If, then, the P. D. is to remain constant at D, that at B. must have a range of from 100 to 104. It is evidently impossible to have C. D. and E. at the same P. D., and the practice is to have the loss between them small and put the loss in the feeder. If such is done, evidently the P. D. at A. B. must be capable of regulation.

Second. Let us consider the case of several such circuits from a constant source. (See Fig. 2). Evidently if any one branch is fully loaded, another one at half load, and another one at very light load, the P. D. at the source can only be regulated to be that which is correct for some one circuit. *In order to make the average P. D. correct,* probably the circuit half loaded would be chosen, if any choice be made, *and if there exists means for determining the conditions and for the adjustment thereto.*

Third. From the condition of Sec. 2, arose the design of the feeder and main system shown in Fig. 1, consisting of a number of feeders, serving one system of mains, of voltmeters to indicate the P. D. at the junction of feeders and mains, and of resistance to cut into the feeders to maintain either constant P. D. at the junction, or to have the same lowered when the C. in the feeder lessens. Constant, or almost constant P. D. is maintained at the bus bars A. and B. The amount of R. was found to be large and bulky, and the manipulation, in large plants, a source of considerable difficulty.

The next step was to employ a large number of feeders and a supplementary source of P. D. greater than that generally needed. When the P. D. at any feeder end becomes high the feeder is cut out; when low, it is thrown into the high P. D. bus bars.

The next improvement was to increase the P. D. by a "booster" and is the method employed on many alternating as well as direct current circuits.

Fourth. The system described in section 3 necessitates apparatus and attention not usually obtainable for isolated plants, but the general principle remains the same, and an isolated plant has before it a choice of evils as has a larger plant, and, in fact, almost every plant of any character. The isolated plant wiring must either be arranged as a number of circuits of the character indicated in Fig. 2, or on the feeder and main system shown in Fig. 1. If Fig. 2 be chosen, there should be indicators of current A. M. for each circuit, and voltmeter at V. M. connected at A. B. and the voltage cut down either to that necessary for the least loaded circuit or slightly above, or means for determining the voltage of one or more distant points, preferably, one of each circuit, and the voltage adjusted thereto. In either case, means must be furnished for regulating the P. D. at the source, and it is very seldom that it is wise to have such P. D. rise in proportion to the current output. Generally, something less is preferable, and any automatic means should so deliver it, leaving hand regulation for the finer adjustment.

Fifth. If only one dynamo is employed, then its P. D. should rise somewhat, but not exactly, in proportion to the current output and the line loss. If a number be employed, it is best not to have them over-compounded at all, or, at most, to only a very small amount, depending upon the ratio of size to total load. (This was explained in the article of Oct. 13.) Also, as the E. M. F. varies according to the temperature of the dynamo, the hand control should have sufficient additional range to compensate for same.

Sixth. Plants having only small wire losses, say 4 per cent. or less, can be operated with a close approximation to accuracy by having the circuits carefully laid out and having quite a number, though not necessarily a "multiplicity," and when it becomes necessary to throw in additional dynamos dividing the circuits, giving some to each dynamo, and, as far as practicable, putting all the light loads on one and keeping its voltage down. When there are not many dynamos there is no trouble or complication in doing this. If, however, it be considered preferable to operate the dynamos in multiple arc, have hand control and means to determine the P. D. at the lamps or the C. in each circuit and the P. D. at the dynamo.

Whether the system of Fig. 1 or Fig. 2 is best to use for an isolated plant, depends upon the conditions of the case. The greatest load, the variation of load as a whole and in the various sub-circuits, must be considered, and also as to whether the control of each circuit from the main switchboard is desirable. Whatever the wiring system, the degree of over-compounding of the dynamos and the amount of wire losses have no fixed relation and hand control is always advisable. If there be only one dynamo and the load increases and decreases in all parts of the circuit in the same ratio, then, and *then only*, should the dynamo be over-compounded in the ratio of the line loss to total load. Even in the last case a hand regulation is advisable to compensate for temperature of the dynamo.

If more than one dynamo be used and the circuit be divided so that each dynamo operates independently, the conditions are similar to the preceding paragraph. If the dynamos be used either individually or collectively, and the series winding be not connected by an "equalizer," the over-compounding of each should be the same as that of the smallest dynamo used, which should be such that when it is operated alone and at full load, the P. D. at the lamp is that desired. If the total line loss be ten per cent. and the

smallest dynamo have a capacity of one-quarter the total load, it should over-compound two and one-half per cent.

Therefore, dynamos, when used as stated, should be shunt wound, or only slightly over-compounded, or connected by an equalizing bar and should always have a hand rheostat.

All other features being equally good, the man who can and does pay attention to the above considerations, produces a better plant than the man who slights them. Possibly the clients will never know the difference, but the designer will, provided he be competent, and that should count for something. If the plant be for incandescent electric lights, special care, instead of general plans, along some broad path intended to be an average and really not suitable to anything, will save the client from one to five per cent. yearly on his investment. The investor is not likely to consider the advisability of purchasing such advice when professional men relegate wiring plants to the "wire man," or the average installing "expert," admirable artisans as such men may be. Even the recently graduated collegian, with his magnificent training for the future, and his lack of knowledge of the conditions of practice, is not the man best fitted to design wiring plans, or to consider the mutual relation of the various elements of the electric light plant.

Transformer Testing.

BY EUSTACE OXLEY.

A transformer of the present day is an exceedingly efficient piece of apparatus, even when operated at small loads, but the combination of a large number of small transformers, with their primaries connected to the mains twenty-four hours out of twenty-four, and with their secondaries open eighteen hours or more out of twenty-four, is a source of loss and inefficiency which has for a long time provided direct current, low pressure advocates with their main argument against the employment of the alternate current system.

If consumers could be provided with a suitable switch for opening the primary circuit of their transformers when their lights were not in use, and at the same time could be relied upon to do so, this loss of power might be avoided; otherwhise, it would seem that the so-called "banking" of transformers, in connection with a low pressure distributing network, was the only remedy.

In a system where every consumer is provided with a separate transformer, this loss at no load is of great importance in determining the all day efficiency, and it is therefore advisable to test all transformers before they are sent out from the central station to be connected with the mains. Tests should be made of insulation, magnetizing current, core loss, efficiency and drop.

Insulation.—The insulation between the coils, and between the coils and the shell, should be able to withstand the application of a

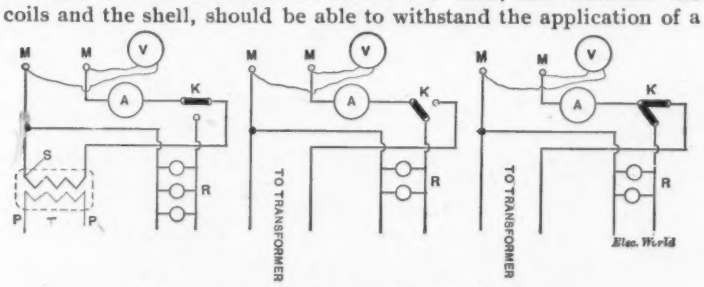


DIAGRAM OF THREE AMMETER METHOD.

P. D. equal to twice the primary voltage at which the transformer is intended to work; thus, a transformer intended for use on a 1,000-volt circuit should be tested for insulation between these parts, with a pressure of 2,000 volts.

Magnetizing Current.—Measurement should be made of the magnetizing current, *i. e.*, the current which passes through the primary coil, when the secondary current is open.

Measurement of Core or No-Load Loss.—The "no load" loss is the power absorbed by the primary, when the secondary circuit is open. There are several well-known methods of measuring the power taken up in a transformer, but they are not all, however, adapted for use in the workshop. Those commonly employed are the "Three Voltmeter" method of Prof. Aryton and Dr. Sumpner; the "Three Ammeter" method (a modification of the first by Prof. Fleming), and various "Wattmeter" methods. The first two are very similar, the difference being that in one case you measure volts, and in the other current; in both a single instrument may be used to take the three readings. Eminent authorities have advocated the use of the wattmeter for measuring power in alternate current circuits; however, workshops are seldom provided with a suitable wattmeter for the purpose. As the three ammeter test can be made with an ordinary Siemens dynamometer and a voltmeter capable of measuring the volts on the low pressure side of the transformers, it is perhaps most generally employed. Although this method has been frequently described, it is possible there are some who are not yet acquainted with it, so perhaps a short description would not be out of place.

To measure the "no load" loss in a transformer, arrange things as shown in Fig. 1, where MM are the secondaries of another transformer providing the proper voltage, A the dynamometer, V the voltmeter, T the transformer under test, P the primary, and S the secondary coil; R is a non-inductive resistance, such as incandescent lamps, and K a three-point switch, conveniently made with mercury cups and copper connecting pieces. The primary circuit is left open during the test. The voltage must be kept steady and at the proper value. Then if C is the current which flows through the transformers alone (when K is as in Fig. 1) and C_1 is the current which flows through the inductionless resistance, R, alone (when K is as in Fig. 2), and C_2 is the current which flows when the transformer and inductionless resistance are placed in parallel with one another (when K is as in Fig. 3), and V is the voltage, read by the voltmeter, then the power in watts absorbed by the transformer will be,

$$W = \frac{V}{2C_1}\left\{C_2^2 - C^2 - C_1^2\right\}$$

the greatest accuracy being when C is made equal to C_1.

Efficiency Test.—When it is required to test the efficiency of a transformer at different loads, taking measurements on the low pressure side, two similar transformers are needed. The primary coils of the two transformers are connected together, and measurements taken of the power taken up by the secondary of the first, and that given out by the secondary of the second. The loss is then divided between the two transformers, and their efficiency determined. Dr. Sumpner has given a method for measuring the iron and copper losses in a transformer by means of a single wattmeter. It consists in measuring the watts taken up by the secondary when the primary circuit is open; this gives the "no load," or "core" loss; then the secondary is short-circuited and the power measured absorbed by the primary when the full load current is passing in the secondary. This gives the "copper" losses, and adding these two together gives the total losses in the transformer.

A method * of finding the efficiency of good, closed magnetic circuit transformers at all loads is to calculate the C^2R losses at different secondary loads, and adding to this the "core" loss, thus getting the total losses at different loads, from which an efficiency curve can be plotted. The "core loss," which is constant at all loads, may be got by multiplying the apparent power absorbed at no load by OS. This last figure is the value of the power-factor at no load, as determined by Prof. Fleming, after an exhaustive series of tests on transformers of different makers.

Regulation.—The drop in the volts of the secondary circuit with increase of load should be measured. The "total drop" being the difference between the secondary volts at no load and full load. This drop of voltage is due to resistance in the primary and secondary coils, and to magnetic leakage. It is of course desirable that transformers for use on lighting circuits should have as small a drop as possible.

Mathematics and—Mathematics.†

A glance through the transactions of learned societies will show how the subject of electromagnetic theory may be treated by men who are only a little better than mathematicians. We say better, because even a little knowledge of nature must improve the pure mathematician, and only the very smallest knowledge of nature suffices to differentiate the pure mathematician at Cambridge from the mathematical physicist. Let us look up an elaborate paper on this subject by a mathematical physicist. We are practically engaged in electrical work, but we think it good occasionally to think of the soul instead of the mere body, and we know that somehow the mathematicians can tell us more about the soul of our subject than we ourselves know. Well, how much of such a paper can any of us understand? There are three or four people in the whole world at the present time (certainly not more than five) who have practical notions of things, and who are also able to thoroughly understand such a paper. If you question the author of the paper, who has written perfectly accurately of current and

* See paper by Professor Fleming, Inst. Elec. Engs., No. 101, Vol. XXI.
†From the London *Electrician*, slightly condensed.

potential, you will find that he knows absolutely nothing of amperes and volts, that he has not the slightest interest in wires or batteries or dynamo machines. And yet those pages of his paper which bristle with mathematical expressions may contain a story which to us is of very great interest, only the author cannot talk our language, and we do not know his. We have almost no common sympathies.

With Mr. Heaviside we are in the company of a very clever, good-natured elder brother, who has exactly the same likings as ourselves for all sorts of experimental work, and who tries to explain deep things to us in language that we can understand. Sometimes he cannot get down to our level; but he always tries to do so, and we ought to try harder to second his efforts than we have hitherto done. It is absolutely certain, it has been proved as clearly as almost any physical fact is ever proved, that electromagnetic energy travels through the space external to a wire, and not in the wire itself, as we used to believe. Is there any electrician who does not know this? Is there one of us, however scornful of mathematicians, who would not give a deal to be able to see clearly, say as clearly as Mr. Heaviside sees it, how the thing occurs? We are willing to give a good deal, but we are not willing to give all that we possess, and that is the price demanded by the mathematician. He says, you must give up all chances of obtaining practical knowledge of electrical things, you must by years of study get familiar with elaborate mathematical expressions, and at the end the sort of notion which you will have obtained is the notion that I have, and not the notion that you think you may have.

What Mr. Heaviside says to us is a very different thing. He will probably be rather angry at our way of putting the matter; but this is how we read him. Look over that elaborate mathematical paper again; you will notice in page after page of it the same mathematical expressions endlessly repeated, for the benefit solely of the printer. They are really very few, and every one has a definite and very interesting meaning. Suppose we do not print them as they stand—let us use Mnemonics. The mathematicians do not need mnemonics; even those of them who have the very worst memories have become so accustomed to these expressions that they glance over a page of new work in half a minute and understand it all. Here is a frightful expression which we see repeated in every other page. Well, then, let us (as Maxwell did) call it curl. But once for all let us try to understand what it means, and we all at once discover (like M. Jourdain, who made the same sort of discovery) that the idea underlying curl has been familiar to us for years, and that if we had not the idea we should know nothing whatsoever about our ordinary practical work. The Greek mathematicians thought it well to make their pupils spend years in leading up to the proof of the 47th proposition of the first book of Euclid. Would there be great harm in telling pupils now-a-days that this proposition is really an axiom, and so save all those years of study? We study for two reasons. One is this, that the mere study is a mental gymnastics; the other to gain knowledge. The best kind of study gives both knowledge and mental power. We electricians have no lack of mental power; if ever practical men had mental gymnastics in greater degree than we, we should like to hear of them. But even our best friends will say that our knowledge of what goes on in the electromagnetic field is rather limited. As, then, our profession may be relied upon to give us an intellectual training, as we have no examinations to pass, as our mathematical tools are for use, not show, it is very important that those tools should be of the very best and latest labor-saving make. Our teachers act on the principle that each of us must only use such tools as each of us himself can make. Prof. Tait is of opinion that no man ought to be allowed to use a table of logarithms until after he can himself calculate logarithms. We presume that he would allow no boy to use a watch until he was able to make one. These teachers of ours gave us all the Euclid we could stand. How unhappy they must be in not being able to teach us multiplication by the Trireme method, and how abominable it must seem to some of them that the decimal system was ever invented. There are still plenty of useless jobs to be done to keep boys dull. Think of making a man spend one year at geometrical conics and the next year at analytical conics, and dosing him with more and more perfect proofs of Taylor's Theorem. These are the memories which cause an electrician to regret his lost youth. Do electricians ever need to solve a triangle, unless it is a simple right-angled one? Are there not curves more interesting to us than conic sections? And seriously, however beautiful Taylor's Theorem may be, does the electrician ever need it? When shall we see a good list made out of the mental tools most needed by the electrician?

The Successful Application of Electricity to the Operation of Mines.

Mr. W. F. C. Hasson recently read a paper before an engineering society of the Pacific Slope with the above title, which forms an interesting contribution to a subject in regard to whose more practical and commercial details he has had unusual opportunities to become informed.

Referring to a statement made at the Electrical Congress held during the World's Fair in Chicago, by one of the most prominent engineers of one of the large manufacturing companies, to the effect that he regarded it the business of consulting engineers to assure the public of the practicability of electrical machinery for the transmission of power, long distances, Mr. Hasson said that the independent engineers, recognizing that the perfecting of electric machinery for long distance transmission would only keep pace with the demand for such machinery, have been compelled to rely more or less upon their own intelligence and reputation for honesty in advocating the investment of money in such enterprises. Heretofore, the data furnished by the electrical companies has been very meagre, and it has been impossible for the engineer to satisfactorily give even preliminary estimates concerning the cost of machinery. The past year has seen great advance in the standardizing of machines and the publication of sufficient information to enable the intelligent investigation of the feasibility of proposed transmissions.

So much, he said, has been written and said about the success and economy of the utilization of water power and the great variety of purposes it may serve when transformed into electricity, that numerous companies have been formed to transmit unlimited power unlimited distances. Incipient electricians, armed with a few figures, great faith and little understanding, see fame and fortune ahead of them, and talk bravely of the possibilities of cheap power for railways, town lighting, manufacturing and mining plants, and irrigation machinery. So powerful is the effect of a small conception of the possibilities of electricity that it apparently induces in the hopeful mind a great and firm belief in itself. Men who have a faint conception of the elementary principles of electricity unhesitatingly state their willingness to undertake the transmission of 20,000 horse power 100 miles, under ground or water, as may be desired. The variety of statements freely furnished investigators leaves them in an uncertain frame of mind as to whether there is any truth whatsoever in claims made for the various types of machinery.

After describing several systems for the transmission of power, Mr. Hasson said there are several companies in the United States prepared to manufacture the necessary machinery to meet any of the circumstances enumerated, and, further, prepared to guarantee its successful operation. It must be borne in mind, however, that guarantee, however responsible the contractor may be, really means but little. Although the payment for machinery may be made dependent upon the fulfillment of the guarantee, this by no means compensates the purchaser for the money lost by delay, and the consequent trouble and worry. The only real safeguard is the selection of such machinery as is known to be successful, and the taking of every precaution that its selection and installation is placed in the hands of capable people, whose only interest is in the successful operation of the machinery—and not in the profits accruing from its sale.

The vital question, in the opinion of Mr. Hasson, is the comparative cost of operation of the mine by electrical machinery, and by steam or water power. In that connection there is presented the absolute cost of electrical machinery and its operation, and the cost of the engine and boiler plant and its operation, to produce equal results at the Standard Consolidated mine at Bodie. At the time the machinery was contracted for this mine there was but little absolute assurance of its successful operation. That the electrical difficulties incident to the locality were little understood by the engineers of the contracting electrical company, is evidenced by the fact that it required the greater portion of a year to get the machinery in successful operation. The figures in this case are as follows:

Expense for electrical machines, water wheels, wire and pole line material, freight, and all construction and installation for a plant to develop 150 horse power at the mill	$26,000
Total expenses, including pipe line and power house and other buildings necessary	$37,000
Estimated cost of engines, boilers, freight, construction, buildings, etc., for a high grade steam plant to develop equal power	$13,000
The expense for fuel for production of power for the year ending February, 1893, was	$22,700

This leaves a balance in favor of steam machinery of $24,000 on first cost, while the fuel expense is completely wiped out by the use of electric machinery operated by water power.

Allowing $700 per annum for heating purposes, the annual saving in fuel becomes	$22,000
Assuming a period of operation extending over 10 years, the amount expended in fuel at 6 per cent. compound interest becomes	$307,000
Against this must be charged the original expense and compounded interest on the extra cost of electric plant over that of steam plant, amounting to	$43,000
The balance in favor of the electric plant is	$264,000
The wisdom of the adoption of electric power in this instance is emphasized by the fact that the average annual dividends for the two years ending February, 1894, was	$28,500

The conclusion is drawn that, all circumstances remaining the same, the saving in fuel will practically double the dividends. The cost of attendance for the electric plant will be slightly in excess of that for a steam plant, but the cost for maintenance and charge for deterioratioin should be less. The Standard Consolidated Mining Company, Mr. Hasson adds, is now making arrangements to install an electric plant for the operation of hoists and mine machinery. This plant will effect an additional annual saving of $11,000, heretofore expended for fuel.

Mr. Hasson also gave an estimate concerning the installation and operation of machinery for a 40-stamp gold quartz mine and mill under the following conditions:

Distance to available water power	20 miles
Capacity of generating plant	300 horse power
Type of machinery	Multiphase, alternating current
Transmission voltage	10,000 volts
Maximum loss in transmission	10 per cent
Demands for power:	
90 horse power for stamps, crushers and concentrators.	
75 horse power for hoists.	
50 horse power for pumps.	
15 horse power for electric lights.	
Annual operation	350 days of 24 hours each
Estimated period of operation	10 years
The cost of necessary electric and hydraulic machinery and wire for transmission, all f. o. b. San Francisco, together with expense for material and construction of pole line and stringing wires, should not exceed	$36,000
The cost of engines and boilers to produce equal results, with the exception of the electric lights, all f. o. b. San Francisco, would not be less than	$10,000
Assuming cost of transportation and installation of the two classes of machinery to be practically the same, the difference in the first cost in favor of steam machinery becomes	$26,000
This, regarded as a 10 years' investment at 6 per cent. compound interest, represents	$46,500
The annual difference in expense for fuel, operation, maintenance, insurance, taxes, etc., in favor of the electric and hydraulic plant, will not be less than	$40,000
Regarded as an annual investment at 6 per cent. compound interest, this in 10 years amounts to	$558,500
The total difference in favor of the electric plant thus becomes	$512,000

From this, of course, must be deducted the accumulated value of the investment necessary for the development of the water power. These estimates, he said, are not to be taken literally, but they truly represent the great margin there is in favor of the electrical transmission of power, when the matter is considered on a business basis.

These results being true (and in one case they have been actually established), Mr. Hasson stated that the question naturally arises as to why there should be any hesitation in the investment of money in power transmission enterprises, and why so little advantage has been taken of the possibilities that exist in that direction on the Pacific Coast. Among the answers that may be given he enumerates the following:

1. The electrical manufacturing companies exploited the field and claimed to be prepared to meet the demands for mining machinery before such machinery had even been designed. Finding that a demand existed, machines were designed to meet ideal conditions. It is by no means surprising that when installed as ignorantly as they had been designed, many unforeseen obstacles prevented the successful operation of these machines. However, it was from a study of these difficulties, and the devising of methods for overcoming them, that perfected systems have finally been obtained. Further, being themselves ignorant of the probable cost of machines, the preliminary estimates were in many cases made so high as to prohibit their use. This is evidenced by the fact that at frequent intervals during the past two years estimates have been made for the cost of machinery to transmit 1,000 horse power in Nevada County, and the present estimate is one-fourth of the original one.

2. There is a definite lack of confidence on the part of the mine owners as to the successful operation of electrical machinery, owing in part to the failures that have occurred due to the causes stated, and in part to the fact that electricity is regarded as a very mysterious element. The manufacturing of electrical machinery is no longer any more of a mystery than that of building engines and boilers. One great error on the part of those investigating the feasibility of employing electric machinery is in relying on the manufacturing companies to freely do their preliminary engineering work. Although the electrical manufacturing companies have been liberal in pioneer engineering work, their province is to make and sell machinery. If they are also called upon to do free engineering work in all parts of the world, and still make a profit on their machines, the prices of necessity must be made high accordingly. It must be self-evident that in relying on the manufacturing company for engineering advice, the purchaser eliminates the possibility of that competition which he should desire. Further, an agent whose salary is dependent on commissions on sales should hardly be placed in the position of giving disinterested advice as to the practicability of any proposed enterprise.

3. In the conducting of any enterprise dependent on cheap power for its success, it would appear essential to retain control of the production of that power. In the development of new industries in California, the tendency is always to look to foreign capital. If the venture fails, the foreign capitalist has a grievance that he ventilates and prevents investments in legitimate enterprises. If the venture succeeds, the chances are in favor of its becoming a monopoly, and the original enterprise is at its mercy. In cases where there are groups of mines dependent on cheap power that requires capital only for its development, it is certainly advisable for the mine owners to strain every resource in order to retain control of the power company.

Mr. Hasson in conclusion states that the following facts are assured:

Electric machinery, guaranteed to efficiently transmit power for multifarious purposes, can be purchased at moderate prices.

Carefully selected, properly installed, and controlled by companies governed by a financial policy that reaches beyond the moment, it can be made to play an important part in the development of the industries of the Pacific Coast. It may be accepted as an axiom that no electrical transmission of power is absolutely impossible, considered as an engineering problem, although it may be thoroughly impracticable from a commercial standpoint.

With the revival of hydraulic mining and the economic methods now offered for the operation of mines requiring extensive power, it would appear that the mining industries of the Pacific Coast, instead of being on the wane, are on the eve of a period of assured success; and the men who have devoted their time, money and energy to the maintenance of those industries during the time of depression are to be congratulated on the bright future in view.

Current and Lines of Force.

BY B. S. LAMPHER.

The following rule gives the relation of the electric current to the lines of magnetic force produced by it:

If you look at the positive (or north) end of an electromagnet, the direction of the current setting up the magnetism is that of positive rotation. Similarly, if you imagine a section made in a conductor carrying a current and look at the positive end of this conductor (*i. e.* the end from which the current is flowing) the direction of lines of force set up about the conductor is the direction of positive rotation. Conversely if you look at the negative (south) end of a solenoid, the direction of the current is that of negative rotation, and if you look at the negative end of a conductor (*i. e.* imagine a section without really breaking the circuit) the direction of the lines of force about it will be that of negative rotation.

Every student of electrical engineering knows that positive rotation, mathematically speaking, is opposite to the hands of a watch, and he also knows what is meant by the positive end of a magnet and the positive terminal of a conductor. Accordingly, if he remembers the rule at all he cannot make a mistake, like substituting "right hand" for "left hand" or "clockwise" for "anticlockwise." It is a positive rule; positive end means positive rotation and positive rotation gives a positive end.

Moving Sidewalks.

A sub-commission of the universal exhibition to be held in Paris in 1900 met recently to consider various proposals brought forward in connection with the exhibition. One of the schemes suggested is by M. Blot, of Paris, for a moving sidewalk, similar to that at the Chicago Exhibition, to be worked by electric power in the grounds. Another project, this by MM. Casalonga and Faure, of Paris, is for the construction of a metropolitan railway operated on the same principle.

Notes on the Management of Railway Power Stations—IX.

BY GEORGE T. HANCHETT.

The Car Equipment (Electrical).

By a careful management of the controller the life of the whole equipment is so much prolonged that a knowledge of it is important. In starting the car, be sure that the switch overhead is closed, the reversing lever in its proper position, the trolley on, and the fuses in place; then move the controller forward a notch. If the car does not start, throw off the controller and examine the switches and fuses. If these are intact examine the ground contact at the wheels. A poor connection is liable to exist at contacts where the pressure is great and the contact apparently clean. For instance the writer has seen the output of a thirty-arc dynamo reduced a hundred volts by greasy brushes and commutator. The sand papering of the commutator and trimming of the brushes increased the output to its proper value.

The car wheels are very liable to make a connection of such a resistance with the track as to cut the current down to such an amount, as to be too small to give the necessary starting torque. By driving the blade of a switch under the wheel from *behind* the difficulty may be removed and the car started. It sometimes happens that one of the motors is cut out. If this is the case the car may not start till the controller handle is moved one half way round on its course or, in other words, to the position where the motors are in parallel. Having started the car, allow the speed to become fixed on one notch before moving to the next. In stopping the car swing the controller handle around to the last notch with moderate speed and throw against the stop with a snap. The best controllers are liable to more or less trouble from the arcs formed at the contacts, and this will tend to obviate it. Do not apply the brake till the controller is completely off.

The rapid reversal of a car is sometimes necessary. In order to give an idea of what is going on at the motor when this is done the following calculation is presented. Consider the case of a twenty-five horse power motor which, working at full load, consumes say 40 amperes. Assume that the combined resistance of the fields and armature is 0.4 ohms. The drop through the armature and fields is then $0.4 \times 40 = 16$ volts. This leaves the back E. M. F., if the trolley voltage is at 500, $500 - 16 = 484$ volts. If the motor be suddenly reversed, the impressed voltage and the back E. M. F. work in conjunction to produce current in the armature. If there were no self induction and the current had time to attain its full value, there would be established, if 500 volts is maintained at the trolley,

$$\frac{500 + 484}{.4} = 2{,}460 \text{ amperes}$$

in the motor. Practically, due to the causes before mentioned, the current will be much less, but in any event it will be of sufficient volume to blow the fuse and will thus deprive the motorman of his most powerful means to prevent an accident at a time when it is most needed.

It is, therefore, absolutely necessary, no matter how urgent may be the necessity of instantly stopping, to be slow and deliberate in reversing the motor. Shut off all current completely and then throw the reversing lever. It will now be found that the first notch of the controller will quickly stop the wheels, the second will not only stop the wheels with a sudden jerk but will skid them the other way and any more notches than this is almost sure to blow the fuse. If the car is moving slowly, more than two notches may be used, but at high speed two will be found sufficient. This is the exact reverse of what the layman would expect, but it is nevertheless a fact. Of course, in urgent cases the quicker the current is shut off and the reversing lever thrown the better, but in turning the current on again it becomes necessary to be deliberate. This combination of first hurried and then deliberate action, is something that few men can accomplish, and so it is best for the average man to strive to attain a cool, precise, deliberate control, for excitement in time of accident will tend to make him rapid, often too much so. Copper wire is used almost entirely for fuses at present. If each motor man were supplied with a number of marked fuses and a record of them kept, a result would be obtained that would give data as to the relative excellence of the motormen and the difficulty of the various routes. The successful manager of a line of steamers has the records of the most minute occurances of every voyage. It is much easier to obtain such data regarding a street railway system, and perhaps that is the reason why it is not generally done.

If an accident happens to one of the motors in the nature of a grounded wire, a burned-out field coil or the like, stop the car and open the trap doors. By turning on the controller a notch the defective motor will at once reveal itself by smoking or flaming at the injured part. Shut off the current at once, and having thus determind which is the injured motor, cut it out, and proceed with the remaining motor.

Remember that pulling down the trolley is a sure cure for any electrical difficulty. Always do this when replacing a fuse and thus avoid a shock. If the trolley comes off while the car is in motion, pull it down at once. Neglect of this may result in pulling down a line of trolley wire or even wrenching the whole roof off the car. For the same reason never run the car backward unless some one watches the trolley, holding the cord in his hand. Whenever the trolley comes off the current should be shut off. Never stop a car on a curve unless absolutely necessary. The large amount of power needed in starting from such a position is liable to seriously damage the motors and gearing. Never leave the car in such a way that it can be operated by any but the proper parties. Remove the controller handles, and throw the overhead switch. In a thunder storm there is very little danger except to the motors. If one of these is damaged, cut it out. If both are affected, pull down the trolley and wait for the next car to push the disabled one to the car barn.

If the two motors face each other between the wheels, as is usual, the strain on the two motor supports is very different. Suppose that we have a 25-hp motor driving the car at ten miles an hour. Assume a thirty-inch wheel.

At this speed it will make

$$\frac{10 \times 5{,}280 \times 12}{60 \times 30 \times 3.1416} = 112$$

revolutions per minute practically. If the motor support be 22½ inches from the axle, the pressure upon it due to the power exerted will be

$$\frac{25 \times 33{,}000 \times 12}{2 \times 22.5 \times 3.1416 \times 112} = 625 \text{ pounds.}$$

On the forward support this force is added to the weight of the motor, while on the rear support it is taken from the pressure of the motor thereon. Therefore, when a motor drops into the street due to the failure of its support, it will be easier on the temporary support to cut the motor out, if it be a forward one, and to allow it to operate, if it be a rear one. The fact that this extra weight due to the power exerted is often overlooked in the design of motor supports, is responsible for many failures.

The current should be shut off when crossing a section insulator. This will save both insulator and motors. Be sure to remove the trolley when inspecting or adjusting the motors. Beside being a protection from shocks it is also a safeguard against short circuits from tools, or knives, keys etc., falling out of the pockets into the motor. A switch or the controller may be grounded, but if the trolley is down the current is positively off. If the trolley flashes on placing it on the wire when the switches are open and the lamps and heaters are off, something is wrong. The conductor should frequently test the car in this way and report it at the station.

The trolley wheel is one of the most neglected parts of the whole equipment. It must turn freely, for if it sticks and skids along the wire, flat surfaces will be produced which, when the wheel is set turning again will cause it to chatter and spark incessantly, and effect speedy destruction. Oil is a good insulator and consequently a bad thing for a trolley wheel bearing. Some modern wheels have graphite bearings, but on the old fashioned trolley wheels a mixture of powdered graphite and oil will be found much better than oil alone.

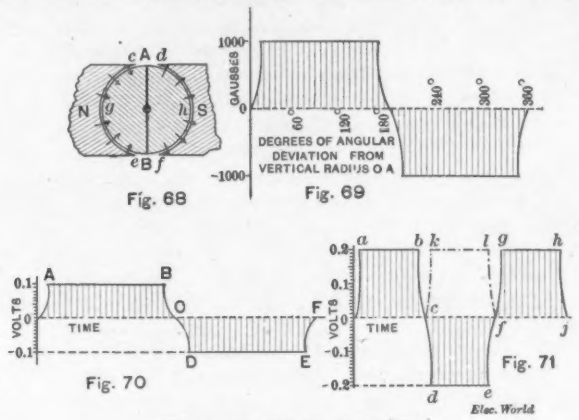
The series parallel controller has been one of the most marked improvements of modern street railway equipment. By its means the car can be operated at half speed at nearly the same economy as at full speed. In crowded cities where the traffic is very heavy and the cars on the suburban lines are few in number, it is safe to say that this controller saves twenty per cent. of the coal bill. In such cases it is, therefore, more economical to discard all other forms. This has been largely done; but in this, as in every other economy, there are a certain class that are blinded to future economy by first cost.

In the management of an electric railway equipment, from boiler down to car, theoretical formulæ and knowledge of principles are of undoubted value, but an abundance of practical knowledge and strong common sense cannot take a second place. The two combined are invincible. A practical college professor once said "The trouble with you technical graduates is that you get a thing ten times too large or ten times too small. The theorist will make this error, and the practical man, while he knows that this cannot be right, cannot calculate what is right, but if either had the others knowledge the mistake would at once be corrected.

Electrodynamic Machinery—XVIII.

BY E. J. HOUSTON AND A. E. KENNELLY.

91. Since, as we have seen, the E. M. F. induced in an armature may be regarded, either as the result of cutting through the flux at the surface, or of altering the amount of flux enclosed by the loops of conductor; and, since in toothed-core armatures, the E. M. F. cannot be regarded as due to the cutting of the flux, it is evident that the more fundamental rule for determining the value of the E.



FIGS. 68, 69, 70 AND 71.

M. F. generated in the armature is that based on the rate of enclosing flux.

92. Fig. 68, shows a single loop of wire wound upon a drum armature, which has by its rotation in the flux, an E. M. F. induced in it of the same type as is graphically represented in the curve of Fig. 69. Supposing that the speed of revolution is such as to produce an E. M. F. of say one volt, in this conducting loop, during its passage beneath the pole faces., then if two turns of wire be wound on the armature at right angles, as shown at *AB*, and *CD*, Fig. 75, they will each generate E. M. F. of the same value, in their proper order, as they pass through the flux, and if the E. M. F. from *AB*, is represented by the curve of *a b c d e f g* of Fig. 74 *A*, and the E. M. F. in the loop *CD*, be represented simultaneously by the curve of *h i j k l m n o* of Fig. 74 *B*, then by properly adding and co-directing the E. M. F's. so produced, by the aid of a suitable commutator, we obtain an E. M. F. of two volts, as shown in Fig. 75 *C*, by the curve *p q r s t u v w x y z z¹ z²*. Moreover, while the E. M. F. produced from one wire alone fluctuates between 0 and 1 volt, four times per revolution, the E. M. F. produced by

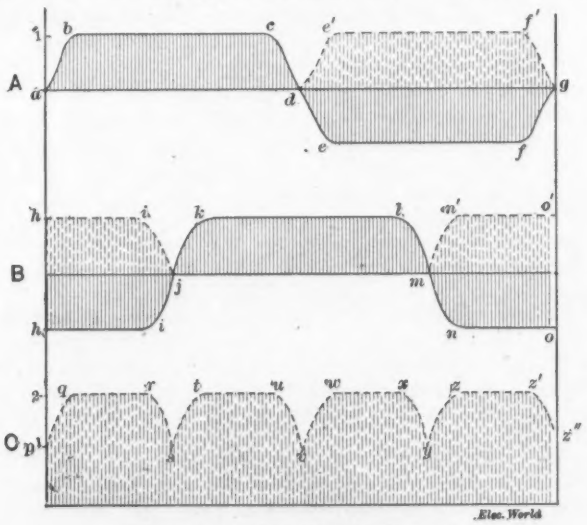


FIG. 74.—DIAGRAMS OF E. M. F.

the combination fluctuates between one and two volts eight times per revolution.

93. If now, instead of two loops being wound on the armature, there are six loops, as shown in Fig. 76, the E. M. F. generated in these, added and co-directed by the aid of a suitable commutator, will be represented by the curve in the same figure, and while the E. M. F. generated in any one of the conducting loops fluctuates between 0 and 1 volt four times per revolution, the total E. M. F. produced under these conditions would vary between 5 and 5.5 volts, 24 times per revolution. In the same manner, if instead of 6 conducting loops being placed on the armature, there are 12 such loops, as shown in Fig. 77, the total E. M. F., if added and co-directed by a suitable commutator as before, would vary between 10.6 and 10.8 volts, 48 times per revolution as shown by the curve.

94. An inspection of the preceding curves of E. M. F. will show that, while the total E. M. F. capable of being produced from a combination of conducting loops, is less than the sum of the maximum E. M. F.'s in each separately, yet their combined E. M. F. is much more nearly uniform than their separate E. M. F's, and tends to become uniform as the number of loops is increased, the curve of the total E. M. F. tending to become more and more nearly a horizontally straight line.

95. In studying the arrangement of the wires on the surface of the armature in a generator, with the view of determining the E. M. F. generated by the revolution of the armature, it is necessary

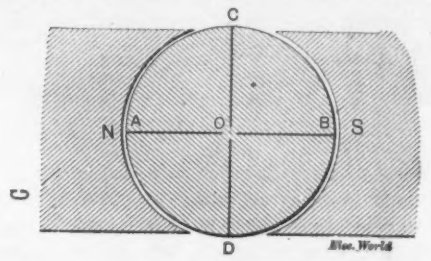
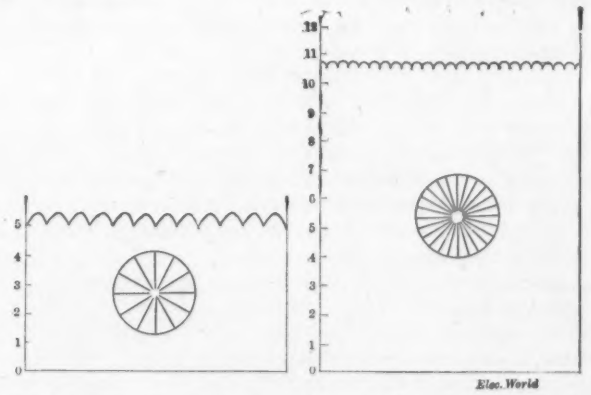


FIG. 75—DRUM ARMATURE WOUND WITH TWO TURNS OF WIRE AT RIGHT ANGLES TO EACH OTHER.

to observe that the E. M. F. developed does not depend directly upon the length of the armature wire which cuts magnetic flux, but does depend dircetly upon the amount of flux enclosed by the conducting loops during their revolution. It is a common error to regard all the wires on the free surface of an armature which does not pass through the magnetic flux as idle wire, and, consequently, detrimental to the efficient operation of the machine. This error arises from regarding the E. M. F. as produced alone by the cutting of flux, whereas in such a case, as for example, a pole armature (Fig. 17), none of the wire cuts the magnetic flux, and consequently would, by the preceding definition, be regarded as idle wire. In reality, the generation of the E. M. F. is dependent on the embracing of flux by the loops, and since the so-called idle wire is necessary to form a part of the loop, it cannot properly be regarded as idle. It is, of course, to be remarked that in the event of the conducting loop having a fairly considerable part of its length formed of the so-called "idle" wire, that in order to permit the loops to embrace a considerable amount of flux during their revolution, requires a rate of cutting flux by those parts that do cut, to be correspondingly increased, thus requiring a greater density of magnetic flux.

That this consideration is correct may be seen from an inspection of Figs. 78 and 79.



FIGS. 76 AND 77.—DRUM ARMATURES OF SIX AND TWELVE EQUIDISTANT TURNS, WITH CORRESPONDING CURVES OF E. M. F.

96. Fig. 78 represents a machine in which the armature is nearly enclosed by polar surfaces, so that, even allowing for the free wire on the sides of the armature, 60 per cent. of the length of the wire is always in the magnetic flux, and 40 per cent. is "idle." Fig. 79, shows a type of armature in which only about 25 per cent. of the length of the wire is at any time in the magnetic flux, so that about 75 per cent. is "idle." Yet in equally advantageous circumstances as regards the cross section of the iron core, speed of revolution, and the number of turns of wire, the E. M. F. from the machine shown in Fig. 79, is fully equal if not greater than that developed in the armature of Fig. 78. If, for example, the polar

surface in Fig. 78, were reduced by cutting it away along the lines *ab*, *cf*, and *de*, thus removing the polar edges, and shortening the polar arc by about 50 per cent., the E. M. F. developed by the generator would not be reduced if the same total quantity of flux

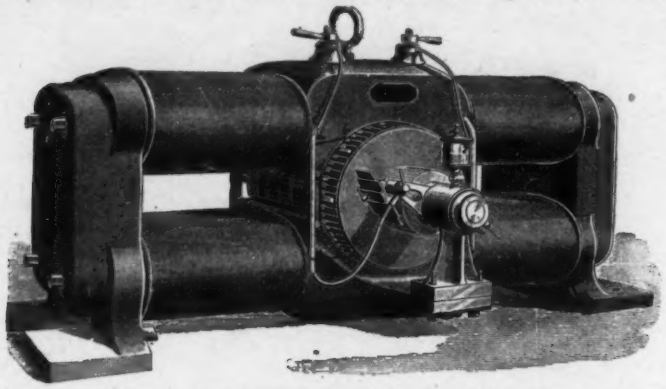


FIG. 78.—TYPE OF ARMATURE HAVING COMPARATIVELY LITTLE "IDLE" WIRE.

were forced through the armature as before. The change affected would be that the reluctance of the air-gap between poles and armature on each side would be increased, since the cross-sectional area of the air-gap would be diminished, and a greater M. M. F. would, therefore, be needed on the field magnets in order to produce the same flux through the circuit as before, but if this flux were reproduced, the amount enclosed with each turn of the armature by its revolution would be the same, and the total E. M. F. induced in

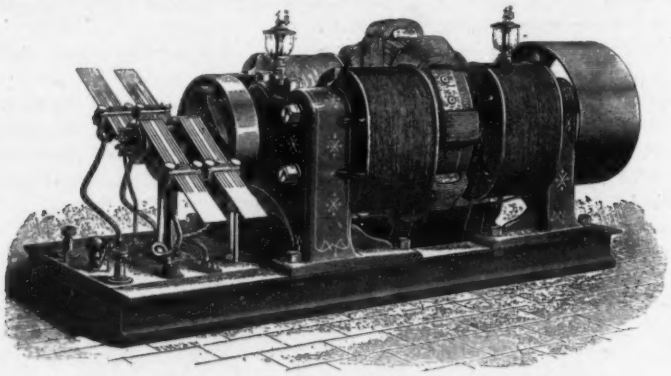


FIG. 79.—TYPE OF ARMATURE HAVING COMPARATIVELY MUCH "IDLE" WIRE.

the armature would be the same; or, regarding the question from a different standpoint, the intensity of flux in the air-gap would be increased about 100 per cent., so that the wires would generate twice as much E. M. F. as before but would only be generating E. M. F. about half the time in each revolution.

(To be continued).

A Rat Did It.

A rat roaming about in the City Electrical Light Works of Baltimore on Friday of last week, played havoc. While investigating behind the station switchboard he stepped from one brass terminal to another, with his front feet on one pole and his hind feet on the other, thus being subjected to 2,700 volts. In an instant there was a flash, a heavy ironstone piece of insulation was smashed, the network of wires blazed up, setting fire to the wooden frames of the switchboard, and hundreds of houses in the down-town streets were plunged in darkness. The hair of the rat was completely burned off and the body became rigid as if suddenly frozen in the act of stepping across the terminals. Although the hair was burned off and even the skull bone protruded, the body being instantly carbonized and rendered rigid, its attitude, when discovered, was life-like and exactly that of a rat stepping accross a small cavity. If the remains are not yet disposed of, Dr. Gibbons would probably consider it a favor to have them forwarded to him for resuscitation.

A Triumph of Electricity Over Gas.

According to London *Electricity*, the Heckmondwike Gas Works has installed an electric light installation to illuminate the purifying shed without the dangers which the use of the ordinary gas light exposes the place to.

Practical Notes on Dynamo Calculation—XX.

BY ALFRED E. WIENER.

36. Total Flux to be Generated in Machine.

The *total flux* to be generated in any dynamo is the product obtained in multiplying its *useful flux* by the factor of its *magnetic leakage :*

$$\Phi' = \lambda \times \Phi = \lambda \times \frac{6 \times b \times E \times 10^9}{K \times N} \quad \ldots\ldots (109)$$

Φ' = Total flux to be generated in machine, in lines of force;

Φ = Useful flux necessary to produce the required E. M. F. under the given conditions, from formula (91);

λ = Factor of magnetic leakage (see chapters 37 to 40).

The value of the total magnetic flux in a dynamo directly determines the sectional areas of the various portions of the magnetic circuit in the frame (see Part III.), and since the magnetomotive force required depends upon the total magnetic flux to be effected, has a direct influence also upon the magnetic winding. In calculating a dynamo-electric machine, therefore, it is of great importance to compute the actual value of the total flux, and, consequently, to predetermine with sufficient accuracy the amount of the magnetic leakage.

But since the dimensions of the magnetic circuit depend upon the total flux to be generated, the accurate value of the total flux, however, is given by the co-efficient of magnetic leakage, which, in turn, for a newly designed machine is to be calculated from the dimensions of the magnet-frame, it is necessary to proceed as follows:

An approximate value of λ for the type and size of dynamo in question is taken from Table LII., chapter 40, and the corresponding approximate total flux calculated from formular (109) With the value of Φ' thus obtained the principal dimensions of the maguet-frame are determined according to the rules given in Part III. The dimensions now being known, the probable leakage factor, λ, can be figured from formula (110), or (111,) respectively, chapter 37, the single terms of which are found by applying the formulæ and rules given in chapter 38 and 39 to the particular type under consideration. From formula (109), finally, the accurate value of the total flux is obtained. Should the latter prove so much different from the assumed aproximate value of Φ', as to necessitate a change in the dimensions of the frame, then the calculation of λ will have to be partly or wholly repeated.

That such a calculation of the probable leakage factor is necessary in every single case, is evident from the fact that not only the leakage in two machines of same general design, and even of approximately the same size, which are merely differently proportioned in their essential parts, may widely differ from each other, but that in one and the same dynamo the amount of the leakage can be considerably varied by using armatures of different core-diameters in its magnetic field.

From the same reason it can also be concluded that the method of assuming a valve of λ from previous experience with a certain type or even with an individual machine, is an entirely unreliable one, and that the calculation of the magneto-motive force based upon such an assumption cannot be depended upon.

The author's method of predetermination of the magnetic leakage from the dimensions of a machine to the process of calculation, to within but a few per cent. of the actual value, is given in the following chapters 37, 38, and 39. Prof. Forbes.*

Logarithmic formulæ 2, heretofore employed for the computation of the magnetic leakage, being too cumbersome for the practical electrical engineer, the writer believes that by his set of simple geometrical formulæ contained in chapter 38, he has removed some of the difficuty experienced in leakage calculations.

37.—Formula for Probable Leakage Factor.

Since air is a conductor of magnetism, the conditions of the magnetic circuit of a dynamo-electric machine resemble those of a closed metallic electric circuit immersed in a fluid. In the latter case, the main current will flow through the metallic conductors, but a portion will pass through the fluid. Similarly for the magnetic circuit, the main path for the magnetic flux being the magnetic circuit of the dynamo, consisting of the iron field-frame, the air gaps and the armature body. The amount of electric current passing through the surrounding medium, the fluid, depends upon the ratio between the conductances of the main to the shunt paths. In order to calculate the amount of magnetic leakage in a dynamo, therefore, it is, analogically, only necessary to determine the ratio between the permeances of the useful and the stray paths.

The leakage factor in any dynamo having a *smooth* armature

*Geo. Forbes, Journal Soc. Telegraph, Engineers, XV., p. 531, 1886.

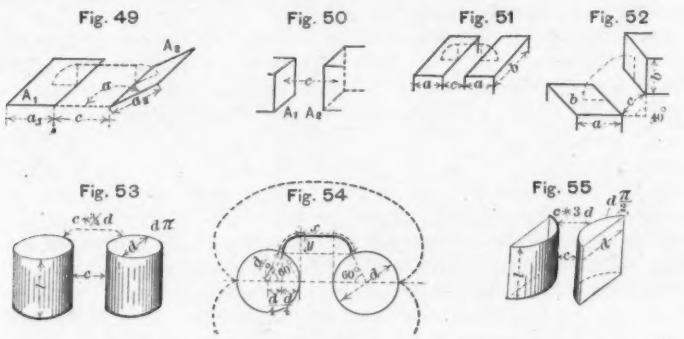
can accordingly be expressed as the quotient of the total joint permeance of the systems by the permeance of the useful path. But since the reluctance of the iron portion of the main path is very small compared with that of the air-gaps; the sum of their reciprocals, that is, the total permeance of the useful path, is practically equal to the permeance of the gaps; hence, the permeance of the gaps can be taken as a substitute of the permeance of the whole magnetic circuit within the machine, and we obtain the following formula for the probable leakage factor of any dynamo having a *smooth* armature:

$$\lambda = \frac{\text{Joint permeance of useful and stray paths}}{\text{Permeance of useful path}}$$

or,
$$\lambda = \frac{P_1 + P_2 + P_3 + P_4}{P_1}, \quad \ldots\ldots\ldots\ldots\ldots\ldots (110)$$

where P_1 = Relative permeance of the air-gaps (useful path);
P_2 = Relative average permeance across magnetic-cores.....
P_3 = Relative permeance across polepieces.....
P_4 = Relative permeance between polepieces and yoke..... } (stray paths).

The relative permeances by which are understood the absolute permeances divided by the magnetic potential, and which, therefore, include a constant factor, on account of the units chosen, are taken for conveniences, for in each individual case the maximum magnetic potential is the same for all permeances and a constant



FIGS. 49, 50, 51, 52, 53, 54, 55 AND 56.

numerical factor, if absolute permeances were used. would be common to all terms in (110), and consequently would cancel.

In order to obtain the probable leakage factor for toothed and perforated armatures, the "factor of armature leakage," (chapter 8) is to be introduced, and we have for this case:

$$\lambda' = \lambda_1 \times \lambda = \lambda_1 \times \frac{P_1 + P_2 + P_3 + P_4}{P_1} \quad \ldots\ldots\ldots (111)$$

Numerical values of λ, for various kinds of armatures are given in Table XI, chapter 8.

38.—General Formulæ for Relative Permeances.

In order to obtain the values of the permeances of the various paths, we start from the general law of conductance:

$$\text{Conductance} = \left\{\begin{matrix}\text{conductivity}\\ \text{of medium}\end{matrix}\right\} \times \frac{\text{Area of medium}}{\text{Distance in medium}},$$

so, in our case of magnetic conductance:

$$\text{Permeance} = \text{Permeability} \times \frac{\text{Area}}{\text{Length}}.$$

Since the permeability of air = 1, the relative permeance between two surfaces can be expressed by the general formula:

$$P = \frac{\text{Mean area of surface exposed}}{\text{Mean length of path between them}}, \quad \ldots\ldots (112)$$

From this, formulæ for the various cases occurring in practice can be derived.

(*a.*)—*Two plane surfaces, inclined to each other.*

In order to express, algebraically, the relative permeance of the space between two inclined plane surfaces, Fig. 49, the mean path is assumed to consist of two circular arcs joined by a straight line tangent to both circles, said arcs to be described from the edges of the planes nearest to each other, as centres with radii equal to the distances of the respective centres of gravity from these edges.

Hence,

$$P = \frac{\frac{1}{2}(A_1 + A_2)}{\frac{c + a_1 + a_2}{2} \times \frac{\pi}{2} \times \frac{\alpha}{180}}, \quad \ldots\ldots\ldots\ldots (113)$$

where A_1, A_2 = areas of magnetic surfaces;
c = least distance between them;
a_1, a_2 = widths of surfaces A_1 and A_2 respectively;
α = angle between surfaces A_1 and A_2.

(*b.*)—*Two parallel plane surfaces facing each other.*

If the two surfaces A_1 and A_2, are parallel to one another, Fig. 50, the angle closed is $\alpha = 0°$, and the formula for the relative permeance, as a special case of (113) becomes:

$$P = \frac{\frac{1}{2}(A_1 + A_2)}{c} \quad \ldots\ldots\ldots\ldots (114)$$

(*c.*)—*Two equal rectangular surfaces lying in one plane.*

In case the two surfaces lie in the same plane, Fig. 51, they enclose an angle of $\alpha = 180$ and the permeance of the air between them, by formula (113), is

$$P = \frac{a \times b}{c + a \times \frac{\pi}{2}}, \quad \ldots\ldots\ldots\ldots (115)$$

a = Width of rectangular surface;
b = Length " "
c = Least distance between surfaces.

(*d.*)—*Two equal rectangles at right angles to each other.*

If the two surfaces are rectangular to each other, Fig 52, the angle $\alpha = 90°$, formula (113,) consequently, reduces to

$$P = \frac{a \times b}{c + a \times \frac{\pi}{4}} \quad \ldots\ldots\ldots\ldots (116)$$

(*e.*)—*Two parallel cylinders.*

In case the two surfaces are cylinders of diameter d, and length l, Fig. 53, the areas of their surfaces are $d\pi \times l$; and if they are placed parallel to each other, at a distance, c, apart, the main length of the magnetic path is $c + \frac{3}{4} d$; hence the permeance of the air between them:

$$P = \frac{d \times \pi \times l}{c + \frac{3}{4} d}, \quad \ldots\ldots\ldots\ldots (117)$$

In this formula the expressions for the mean length of the path is deduced from Fig. 54, in which it is assumed that the mean path consists of two quadrants joined by a straight line of length c, and extends between two points of the cylinder-peripheries situated at angles of 60° from the centre line.

Since in an equilateral triangle the perpendicular, dropped from any one corner upon the opposite side, halves that side, the perpendicular, from either of the end points of the mean path upon the centre line, bisects the radius of the corresponding cylinder-circle, and the radius of the leakage-path quadrant is $y = \frac{\alpha}{4}$, hence the length of the mean path:

$$x = c + y \times \pi = c + d \times \frac{\pi}{4},$$

or, approximately: $x = c + \frac{3}{4} d$.

This approximation even better meets the practical truth, as most of the leakage takes place directly across the cylinders, and the mean path, therefore, in reality is situated at an angle of somewhat less than 60°, which was taken for convenience in the geometrical consideration.

(*f.*)—*Two parallel cylinder-halves.*

If two cylinder-halves face each other with their curved surfaces, Fig. 55, the mean length of the magnetic path is $C + .3\,d$, where c is the least distance apart of the curved surfaces, and d the diameter of the cylinders, and we have for the permeance:

$$P = \frac{d \times \frac{\pi}{2} \times l}{c + .3\,d} = \frac{d \times \pi \times l}{2c + .6\,d}, \quad \ldots\ldots\ldots\ldots (118)$$

The mean length of the path is geometrically found from Fig. 56, as follows:

$$2z^2 = \left(\frac{d}{2}\right)^2; \quad z = \frac{d}{2}\sqrt{\frac{1}{2}}$$

$$\therefore y = \frac{d}{2} - z = \frac{d}{2}\left(1 - \sqrt{\frac{1}{2}}\right) = .15\,d$$

$$x = c + 2y = c + .3\,d$$

For in this case, the extent of the leakage-field is much smaller than in that of full cylinders, and the mean-path can be assumed a straight line meeting the two semi-circles at an angle of 45° from the centre line.

(To be continued.)

The Architect and the Electrical Engineer.

BY KEPPELE HALL.

The now almost universal practice of providing new buildings with interior conduits, and wires for lighting by electricity, seems to afford an opportunity for a few words in regard to the relation between the architect and the electrical engineer.

The writer has been led to a consideration of this question by the fact that a goodly proportion of the specifications drawn by architects for electric light and power installations are very faulty, allowing the contractor to perform poor work in many instances; in others, to require an unnecessarily expensive outlay, which has to be borne by the owner; and in the majority of cases, leaving the contractor a margin for "extras" which is alarming.

There is a great deal of competition in electrical construction work, and in competitive bidding the large firms and the small ones have learned that in order to secure a contract they must cut down the margin of profit to the lowest possible limit. The result is obvious. Give a contractor a set of specifications loosely drawn up. He cannot afford to put in an estimate covering defects in them, as then his bid will be too high. Accordingly, he bids in "conformity to specifications," and before his work is good enough to give any kind of satisfaction or pass the inspection of the Underwriters' Associations, the owner must pay for "extras" 15, 20 or even as high as 50 per cent. more than the contract has been awarded for.

There are architects who regularly employ engineers to draft specifications for them, and this is as it should be, but a great many use one specification over and over again, adapting the same to different conditions. In electrical wiring it very seldom happens that two or more cases are identical. We have had specifications calling for "no more than 3 per cent. drop from mains to any lamp when all are burning," and yet no mention of the number of lights per outlet, leaving the bidder at a loss to know whether to calculate for No. 0 or No. 14 wire.

Others, showing markings and corrections that indicate clearly that the same copy has been used for a number of different cases, call for location of cut-out boxes in the most unsuitable places, because in a different building for which the specifications were originally drawn that place was the most advisable; and demanding provision for the "three-wire system" in towns where there is not the remotest possibility of its ever being used.

These are but few of the defects that could be pointed out. The gist of the matter is easily seen. The architect is not an electrician, nor is he capable in most cases of superintending a piece of electrical work which needs expert surveillance. The owner should insist upon having his work done under the supervision of an electrical engineer, whose practiced eye will avert or detect defects in workmanship and materials, which otherwise will remain unnoticed until too late and cause no end of trouble and expense.

Symbols and Abbreviations.

To the Editor of The Electrical World:

Sir:—We notice, in your issue of the 1st of December, an extract from the London Electrical Review of the 16th November, containing some editorial remarks concerning the symbols and abbreviations recommended by the Committee on Notation, of the Chamber of Delegates, of the Chicago International Electrical Congress of 1893. The editor urges the following objections against the general adoption of these symbols and recommendations; namely,

(1.) That there is no valid reason for prefering script to block letters for symbols.

(2.) That time would be saved to the large army of professors and lecturers by the employment of **M** and **H** instead of the troublesome French script.

(3.) That to employ French script would mean learning a new alphabet.

(4.) That the block letters have been, and are being, used by nearly all the leading writers on magnetism at the present time.

(5.) That the word "intensity" has no meaning in the English language, as applied to the strength of electric current, and that, therefore, the initial letter *I* should not be used to replace *C*.

(6.) That the American Institute of Electrical Engineers has, by the adoption of the symbol, $C = \frac{E}{R}$ upon the Institute badge, tacitly censured the recommendations of the Congress Committee

Replying to these, seriatim, we would say,

(1.) We acknowledge that there is no apparent reason for preferring script to block letters, unless it be that block letters are generally used to designate vector quantities, and that not all the magnetic symbols stand for vector quantities.

(2.) The question here would appear to us whether the amount of time that might thus be saved, would not be more than offset by the necessity which would exist for learning and explaining the different symbols otherwise employed in different countries.

(3.) The argument that the use of the French script would necessitate the learning of a new alphabet necessarily falls, since an inspection of the symbols proposed discloses the fact that but seven symbols are printed in script, so that these seven only would require to be learned, and not an entire alphabet.

(4.) While it is true that in many leading text-books on the subject of magnetism block letters are employed, yet these books had nearly all been written before the session of the Congress Committee.

(5.) It is true that the word intensity of current would require to be explained to the student, to show the application of the symbol *I*, instead of *C*, for current strength.

(6.) The American Institute of Electrical Engineers adopted the symbols on its badge before the session of the Chicago Congress, and there is no record of any action taken by the American Institute upon the subject.

It seems to us that it is not a question as to what particular set of symbols would be best suited to the language of any one nation, but rather how much greater a degree of advantage would be secured by the sacrifice of some individual preference or advantage, for the sake of universality of notation. The advantage of an international system is, of course, to be found in the fact that it creates an international language, and that any local inconvenience that must necessarily arise in such compromise, would be more than off-set by the convenience and simplicity secured.

In order to meet this international adjustment, the French have apparently been willing to introduce a new letter into their technical alphabet, by the use of *W* for electrical energy, and, in the same way, each language has suffered to some extent by the system of symbols proposed. We surely owe something to France, if only for the creation and introduction of the decimal metric system, the foundation of the C. G. S. system, and, while therefore we would prefer to have *C*, instead of *I*, as the symbol for current strength, yet we consider that the disadvantage of the symbol *I* will be more than offset by the advantage of the international co-operation in electrical engineering symbols and abbreviations..

We earnestly hope, therefore, that the recommendations of the Congress Committee may meet with cordial support in all parts of the world where electric engineering is carried on; for unity of notation is a step towards progress, amity and civilization.

EDWIN J. HOUSTON AND A. E. KENNELLY.
Laboratory of Houston & Kennelly,
Philadelphia, Pa.

Fly-Wheel Accidents in Power Houses.

To the Editor of The Electrical World:

Sir: As one way of preventing the danger of fly-wheels bursting through the cause suggested by Mr. R. Fleming (in your issue of Nov. 24th), that is, by a generator being reversed and for the time converted into a motor which might run away with the engine, I would suggest an automatic cut-out as follows: Place in a shunt across the dynamo terminals an electric magnet having a polarized armature. Connect in such a way that when the direction of current is normal in the dynamo; the magnet will attract its armature, so preventing any jar or other cause from operating the cut-out. Should, from any cause, a current be sent through the dynamo in the reverse direction, the magnet armature would be at once repelled and forced against a back contact, closing a circuit through an electro-magnet, which would release a spring circuit breaker, thus opening the dynamo circuit Such a circuit breaker would not interfere with an ordinary overload breaker, since it only acts as a reversal of the current. With such an arrangement it would be impossible, so long as it was in working order, to keep the dynamo in circuit, when not generating. A. H. BURNETT,
Englewood, N. J.

Resistance of the Human Body.

The much vexed question of the resistance of the human body has been solved, it is said, by a Frenchman, who states that its resistance when placed in a bath of water is slightly greater than that of the volume of water which it displaces

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Cold Light.—A long editorial on "An Outstanding Problem" in the Lond. "Elec.," Nov. 16, discusses this subject in an interesting way but without giving any data; it states that the problem is really that of exciting definite single waves of radiation, imple waves of one given wave length; the statement "light without heat" is claimed to be erroneous and should be "light without unnecessary heat;" what is really desired is to be able to transform any amount of non-radiant energy into an equal amount of radiant energy of an absolutely controllable character as regards wave length; the difficulties in controlling such wave lengths are discussed and are said to be greatest in solids and liquids and least in gases; "it is in the fewness of molecules and the simplicity of molecural structure that the hope of solving the problem mainly appears to lie." Two lines of research are open, the first and chief one, which seems most likely to yield the best results, is to excite definite radiation by directly electrical means, and the second is in heating to incandescence solid bodies which possess an abnormally high coefficient of emissivity. Experiments seem to show that it is not impossible to reduce the molecular structure of a substance whether of solid or gas to such a condition that it will emit an abnormally large proportion of luminous radiation, and if so, one of the practical phases of the problem is to contrive to stimulate radiations, and if possible to make that molecular condition permanent.

Light from High Frequency Currents.—Mr. Guillaume in "L'Ind. Elec.," Nov. 10, gives a good description of the recent researches of Prof. Ebert (see Digest, Oct. 6, and Electrical World, Nov. 3, p. 467); the article appears to contain little that has not been included in these references, except the illustrations which include that of the condensers and coils.

Phosphorescence of Incandescent Lamps.—A writer to the "Elek. Zeit.," Nov. 15, states that with a certain lamp he found that on attempting to put it into the socket it phosphoresced sufficiently for one to see the whole lamp distinctly and even see the hands of a clock near the lamp: he believes that it was caused by the rubbing of the bulb by the hand; the same thing was tried with a number of other lamps but only one was found which could be made to phosphoresce. Another writer to the Journal says the information is not sufficient to explain the cause; he believes that it is due to one pole of the lamp being connected to the circuit of which the other pole was grounded, thus producing a difference of potential of 100 volts between the filament and the hand and that the lamp probably had a bad vacuum and one at which the conductivity of the rarefied gases was at a maximum.

Conductivity of Solutions.—In connection with the conductivity of aqueous solutions, in which a portion is replaced by a non-electrolyte, the Lond. "Elec. Rev.," Nov. 16, calls attention to a paper by Mr. Strindberg from the "Zeit. feur Phys. Chem.," vol. 14, page 161, whose results agree with those of Arrhenius, whose formula is given, but differs from those of Holland.

Potential Determinations.—Some abstracts from a paper by Mr. Neuman from the "Zeit. feur Phys. Chem.," vol. 14, page 193, are given by the Lond. "Elec. Rev.," Nov. 16; they refer to the estimation of the potential of hydrogen and some of the metals.

Dielectrics.—A French Academy paper by Mr. Pellat on the force acting at the surface of separation of two dielectrics is reprinted in "L'Ind. Elec.," Nov. 10; in the general case the force is normal to the surface of separation and in the direction in which the specific inductive power diminishes.

Thermo-electric Force Between Electrolytes.—Mr. Bagard's paper from the "Ann. de Chim. Phys.," September, 1894, mentioned in the Digest, Nov. 17, is abstracted at some length in "L'Eclairage Elec.," Nov. 3.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Influence Machine.—An improvement by du Rocher is described in "L'Elec.," Nov. 10; its object is to enable one to increase or diminish and therefore to regulate, the output of such a machine; it consists in the use of special condensers of small capacity, having only one pole, the air forming the second pole; one form of these condensers consists of a bulb containing a metallic filament connected with an exterior piece of metal for forming contact, a Crooke's vacuum being formed in the bulb; this bulb is placed in the electric field of a machine and is connected with one pole; such condensers, if of small volume, increase the voltage of the machine and those of large capacity increase the output considerably; by connecting and disconnecting them the voltage and the output may be regulated; the system is based on Faraday's theorem, that when an electrolyzed body is completely surrounded by a conductor there is produced by induction on the interior of this conductor a charge equal and of opposite sign to that of the electrified body; the theorem may be demonstrated by taking metallic cylinders connected to the machine and surrounded by cylinders of celluloid which are preferable to glass; such a system is charged like the condensers above mentioned, but it is incapable of replacing these.

Standard of Light.—The article by Mr. von Hefner-Alteneck, abstracted in the Digest, Sept. 29, written in defense of his standard, is abstracted in the Lond. "Elec.," Nov. 16. A brief description of the Reichsanstalt standard (see Digest, June 2 and Sept. 22) is published in the Lond "Elec. Rev.," Nov. 16. (In regard to the standard proposed by the Reichsanstalt, attention is here again called to an important criticism by Mr. Guillaume abstracted in the Digest, June 9 and 16.)

Pupilometry and Photometry.—In "L'Eclairage Elec.," Nov. 3, Mr. Henry begins an article on this subject, the present portion being on a new law for the contraction of the pupil; he describes some new researches in this direction.

Symbols and Abbreviations.—The Lond. "Elec. Rev.," Nov. 16, replies editorially to Prof. McFarlane's letter (see The Electrical World, Oct. 27, p. 446); the full reply is published on page 568 of the present issue.

TRANSFORMERS.

Principles of Transformer Design.—The article by Mr. Still is continued in the Lond. "Elec.," Nov. 16. He discusses the wattless and hysteresis components of the magnetizing current, representing them with diagrams; also the maximum and mean values of the current and E. M. F. Regarding choking coils he gives the following formula:

$$E = \frac{4.44\, N\, n\, T}{10^8}$$

by the aid of which a choking coil may be designed to give any required back E. M. F.; E represents the square root of the mean square value of the E. M. F., M the maximum value of the magnetization, that is the number of lines in C. G. S. units, n is the frequency and T the number of turns of wire in the coil; the number of volts is not equal to the difference between that of the circuit and that to which it is to be reduced, but is equal to the square root of the difference between their squares, which gives a considerably greater value; he adds that it is probable that the closed magnetic circuit is not suitable for cutting down the voltage from 100, for instance, to that required by an arc lamp and that a small air-gap in the magnetic circuit may be an advantage; for calculating N he gives the following empirical formula for the ampere turns required per inch length of the iron circuit and applies to a very good quality of transformer iron

$$\text{Amp. turns per inch} = \frac{\mathfrak{B}}{10{,}000} + 2$$

in which $\mathfrak{B}$ is the induction in the iron in lines per square inch; for the average quality of iron the formula

$$\frac{\mathfrak{B}}{9{,}000} + 3$$

is perhaps more generally useful. These apply to cases where $\mathfrak{B}$ lies between about 12,000 and 40,000 and are based on the assumption that the curve connecting the exciting force and induction is a straight line between these limits; for air he gives the formula

$$\text{Amp. turns per inch} = 0.313\ \mathfrak{B}$$

which is true for all values of $\mathfrak{B}$. For calculating T it is generally sufficiently accurate to assume that the maximum current is 1.4 times the square root of the mean square. He then discusses transformers, first for an open and then for a closed secondary circuit; in the former case the wattless component is obtained by dividing the maximum value, as given by the above formulas for the ampere turns, by 2.6, which is an empirical constant without any physical meaning and is found to be about right for the low inductions generally used for transformers, but for high inductions it may be many times greater than this; the hysteresis component is obtained by dividing the total open-circuit loss in watts by the E. M. F. in volts supplied to the transformer; the true magnetizing current is the resultant of these two currents, differing in phase by one quarter of a period. The power factor is the ratio of the true watts to the apparent watts on open circuit, the latter being the E. M. F. multiplied by the total magnetizing current; in a good transformer with closed iron circuit the power factor is generally about 0.7; a small power factor is no indication of low efficiency and effects only the loss in the mains.

ARC AND INCANDESCENT LIGHTS.

Continuous and Alternating Current Arcs.—A discussion of Dr. Fleming's article abstracted in the Digest Nov. 17, is published in London "Lighting," Nov. 8 and 15, the discussion having been contributed since the recent publication of that paper. Mr. Crompton thinks the tests are satisfactory and the results conclusive except in that it is not stated whether the same quality of carbons was used for both classes of arcs; he himself has obtained efficiencies somewhat higher than these; he believes that if carbons are specially prepared for the alternating arc and if somewhat higher voltage is used in this, much better comparative efficiencies will be obtained; it is a well-established fact that small alternating arcs are to be avoided, below 12 to 15 amperes they exhibit the defects in an exaggerated manner; it is difficult for the manufacturer to keep arc lamps in stock as they depend on the particular kind of current used. Mr. Preece criticises the paper unfavorably, stating that the experiments were made when alternators were very poor as compared with those of to-day, and he thinks the conclusions might be different if the experiments were repeated at the present time; to use one and the same form of lamp for both is the very thing which gives improper, imperfect and misleading results; he does not favor the use of the colored screens; he suggests that the use of an adjustable choking coil in series with the arc would have stopped the fluctuations which he spoke of; he believes that the facts observed lead to different conclusions from those deduced by Dr. Fleming, and he does not think they show any general inferiority of the alternating lamp; he believes that the same energy expended in the arc, may, if the conditions are the proper ones, be equally effective in practice. Mr. Raworth thinks that one of the vital questions is the value of the illumination at the points equally distant between the two lamp posts, and that it is immaterial whether there are a few hundred candles more or less at an angle of 40 to 50 degrees. Mr. Uppenheimer states that although cored carbons are more expensive, the fact was overlooked that with alternating currents carbons of smaller diameter may be used for the same current, and the cost therefore will be identical or even less; he states that it cannot be maintained that the attaching of a reflector close to the arc introduces complications, as this has been in use for a number of years. Mr. Hesketh objects to the direct current system on account of the complicated nature of the generating plant and its untrustworthiness; the plant takes up valuable space and requires extra labor, repairs being frequently necessary; he favors using only one type of generating plant; he thinks alternating arcs of 15 to 18 amperes will come into favor; rectified currents will prove the most serious opponents to alternating currents for public arc lighting. Mr. Proctor thinks the results for alternating currents may be greatly improved by proper proportioning; the advantage of separate series system is that all the lights may be turned on or off at the same time from the central station; he believes that the street and private lighting systems should be kept entirely separate, and that a saving of the apparatus required would compensate for the increased capital outlay for the separate plant; in Bristol, where both of the systems are in use, the results are in favor of the continuous current. Mr. Stewart suggests that with a frequency of 40 to 50, very much better results in the efficiency would have been obtained; he recommends a large upper carbon and a small lower one. Mr. Wright does not favor a separate system for street lighting from a station using alternating currents, and he thinks the advantage in switching on the lamps from the station have been overrated, as it is necessary in any case to send an inspector to examine the lamps.

Increasing the Life of Carbons.—An apparatus identical with the one described in the Digest, Nov. 3, but under another name, is described and illustrated in the "Elek. Zeit.," Nov. 15; the principle of it is to surround the lower end of the upper carbon with a hood open at the bottom so as to keep the point of the carbon surrounded with an atmosphere of the products of combustion. The apparatus is shown in the adjoining cut; the large hood is hollow and the upper carbon passes

Arc Carbon Economizer.

through it but does not project; the whole apparatus is carried by the lower carbon by means of the three platinum points which rest on the conical surface, and it therefore feeds down automatically as the lower carbon is consumed; the nuts on the side enable the apparatus to be adjusted; the results of a series of photometric and efficiency tests made at an institution in Vienna, are given, and show that the amount of light given off is practically the same with or without this apparatus; when the end of the upper carbon is on a level with the bottom of the hood there even is an increase of 6 per cent. in the light; the hourly consumption of the upper and lower carbons was 14.1 and 15.5 millimeters respectively, when the apparatus was not in use, and 4.9 and 10.0 respectively when the apparatus was used; it appears that the only part which needs to be replaced is the hood, which lasts about 500 to 800 hours.

Poles for Arc Lamps.—A system is described and illustrated in the "Elek. Zeit.," Nov. 8, in which the lamp is suspended over the top of the pole but can readily be lowered down on the side; the pole, therefore, does not cast a shadow.

Illumination.—In the serial of Messrs. Pentland & Gibbings in London "Electricity," Nov. 16, the subject of illumination is discussed, with a view to show how the position, number and candle-power of lamps is to be determined; the terms luxes, photes and lumens are used as units, the latter representing photes per square foot per second.

Incandescent Lamp.—The serial from the French, by Mr. Bainville is continued in the Lond. "Elec. Rev.," Nov. 16. A short summary of the serial is published in the Lond. "Elec. Eng.," Nov. 16. The original is continued in "L'Elec.," Nov. 10.

Cored Carbon Litigation.—The "Elek. Zeit." Nov. 8, publishes some information regarding the recent litigation in Germany.

ELECTRIC RAILWAYS.

Traction—"L'Ind. Elec.," Nov. 10, publishes at some length the first part of an interesting article by Mr. Pellissier, in which he discusses the various traction coefficients, the present portion being devoted to rolling friction, curves, air resistance, grades and starting. The article is in general a compilation of published matter and contains numerous constants and results of experiments, taken almost entirely from American sources, and therefore giving little if anything new, although the matter compiled is of considerable value. Regarding the recovery of energy on a down grade, he states that on the electric rack road at Barmen about one-third of the energy required on ascending is recovered on descending.

Street Railways in Budapest.—According to the "Elek. Zeit," Nov. 15, all the horse car lines in that city are to be transformed into electric lines; those in the dense part of the city are to be constructed like those at present in use there, with a conductor in a slotted underground conduit, while those in the outlying districts are to be run as trolley lines; the milage of the horse car lines at present is 27.6, carrying 350 cars; the change is to be completed during the next year, and is to be carried out by the firm of Siemens & Halske; by means of a special construction the cars will be able to run from the conduit portion to the overhead portion without delay in making the change. The construction of the underground line is progressing faster than was anticipated, and it is thought that it will be completed during the fall of next year.

Electric Traction.—The paper mentioned last week by Messrs. Blackwell and Dawson, is continued with a large number of illustrations in the Lond. "Elec.," Nov. 16.

Electric Traction in Germany.—Some figures from a book recently published by the General Electric Company of Berlin, regarding ten important roads in Germany, are given in the Lond. "Elec. Rev.," Nov. 16.

Accumulator Traction in Paris.—A brief description, with ilustrations of the cars, is published in "Ind. and Iron," Nov. 9.

Municipal Purchase of Tramways.—A discussion by a deputation from the Tramways Institute is published in the Lond. "Elec.," Nov. 16.

Light Railways.—An article from the London "Times" is reprinted in the Lond. "Elec.," Nov. 16.

Electric Railroad on Ice.—According to the "Elek. Zeit.," Nov. 15, a winter electric road is to be constructed in Finland over the ice covering a body of water. The speed is to be 13.6 miles per hour.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

The Future of Central Stations.—A lecture by Mr. Ferranti on the electrical developments of the future is published in London "Lightning," Nov. 15. He discusses the possible improvements in the near future in the generation of electricity and the effects realized if electrical energy is cheap. Regarding the improvements in central stations he thinks the solution of cheap motive power is to be found in the gas engine; he thinks it will be possible in the future to increase the productive power of a given amount of capital expenditure in central stations ten times; electricity should be produced at about one-fifth the amount of coal now used; when running continuously the energy might be produced for one-third the amount of coal that is required when the load is a varying one; an improved load factor will be the result of a cheaper supply; higher pressures than those employed to-day will be used; he considers the charging system at Brighton, in which the Wright "demand moter" is used, is an excellent one, as it gives the consumer who uses current for a large number of hours an advantage over the one who uses a large number of lights for a few hours only; he also recommends the system at Bolton, in which the central station undertakes to do the wiring and fitting for the consumers on the hire-purchase system; he puts stress on making the electric light popular.

Rectifier.—A new form which dispenses with commutators, and suggested by Mr. McElroy, is briefly described in "Ind. and Iron," Nov. 9; the description, however, is not very clear; it consists of "an indicator alternator, which has two pairs of magnets and coils and an indicator armature having only half the number of teeth corresponding with the pitch of the magnets;" it appears that a counter E. M. F. is produced in certain coils which will prevent the current flowing through

them. It is admitted that the efficiency would not be as high as in a commutator rectifier.

Lighting Installations.—A paper by Mr. Henderson is published in the Lond. "Elec. Eng.," and "Elec. Rev.," Nov. 16; he discusses installations which have not passed the examination of the supply companies' inspector.

Electricity from Gas.—The Lond. "Elec. Eng.," Nov. 16, illustrates and describes briefly the system of Mr. Thwaite, fuller details of which are promised later, of a steam coal gas generator for driving gas engines; he claims that there will be considerable saving in coal by converting the coal into gas and using it in gas engines instead of using it for steam engines.

Current Indicator.—A simple device for indicating reverse current in accumulator circuits or when dynamos are connected in parallel, is described and illustrated in the "Elek. Zeit.," Nov. 8.

Hampstead.—A description with a number of illustrations is published in the Lond. "Elec. Eng.," Nov. 16.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone.—A new form by Mr. Ohensorge is described in the "Elek. Anz.," Nov. 8. It consists of a coil having a movable core, one end of which is attached to the membrane, the core consisting of a spiral of iron wire; it is said that such telephones are extremely light and are precise in their action, but heretofore they have not been sufficiently loud; he finds that the loudness is increased very greatly when only a part of this spiral projects into the opening in the coil; the loudness is still further increased if the spiral is made of hardened magnetized steel and it will then serve also as a transmitter.

Domestic Telegraph and Telephony.—An improved system for hotels and large buildings is described and illustrated in the "Elek. Zeit.," Nov. 8.

Fire in a Telegraph Building.—The "Elek. Zeit.," Nov. 15, describes a recent fire in a German telegraph building in which considerable damage was done.

Block System.—The Tyer's electric system is briefly described and illustrated in the Lond. "Elec. Rev.," Nov. 16.

ELECTRO-CHEMISTRY.

Electricity Direct from Coal.—The paper by Dr. Borchers, mentioned in the Digest, Nov. 17, is published in full in the Report of the German Electro-Chemical Society. He considers his experiments as only preliminary; the cell consists of oxygen in the form of air, carbonous oxide or generator gas, and an electrolyte of a solution of cupric chloride which absorbs both carbonous oxide and air equally well; as he desired to make the apparatus practical he could not use platinum electrodes but used copper instead for the pole at which the carbonous oxide is to be dissolved, that is for the anode; the retaining cell may therefore be made of copper and serve as one of the electrodes. An illustration of the apparatus used in the test is given as also the table of results; at shor circuit 0.64 amperes was obtained and on open circuit a maximum of 0.56 volt; an acid solution gave better results than an alkaline one and the copper electrode should be covered with copper filings; theoretically the combustion of carbonous oxide should give 1.47 volts, the efficiency in these experiments for the conversion of coal into electrical energy was therefore 27 per cent. (this, however, appears to be based on the relation between the observed and the calculated voltage); if the gas also contained hydrogen and hydrocarbons the action would be still better; the combustion of coal into carbonic oxide should give about 2 volts; in his experiments 0.3 was obtained, giving an efficiency of only 15 per cent.; the use of coal is almost prohibitive on account of the frequent renewals of the solution which it necessitates; he concludes that the only promising method is therefore to convert the coal into gases and then use these gases in the battery. He describes and illustrates two proposed cells of a practical nature, one for using gas and the other for coal, but he has not yet tried them as they are not finished; they are based on the conditions given by Prof. Ostwald (see Digest, ————); he concludes that the problem of the cold combustion of the gaseous products of coal and oil, in a gas battery and its direct conversion into electrical energy can certainly be accomplished and he thinks it will be done with apparatus somewhat like that which he describes. In the discussion Dr. Vogel discussed the question of efficiency and asked how much of the gas was consumed; Dr. Borchers replied that some would necessarily be lost, but that it is well known that the absorption of the gas in the liquid is rapid and complete and that the same gas may be passed through several cells. Dr. Nernst stated that some time ago he suggested the following indirect solution: to convert the chemical energy of the coal first into some other chemical energy and then this into electrical energy, as for instance, by using zinc and afterwards reducing the bi-product by means of coal; another suggestion is to construct an accumulator which will stand a very high temperature and has a great temperature coefficient; it would be charged at a very high temperature when its counter E. M. F. was low and would be discharged cold when the E. M. F. was high; he also suggests that the maximum possible efficiency is not known and that as much as 130 per cent. might be obtained by the simultaneous absorption of heat from the surrounding air.

Gas Battery.—"L'Eclairage Elec.," Nov. 3, abstracts a Physical Society paper by Messrs. Colardeau & Cailletetoп on the condensation of gases by platinum and other metals. Experiments were made with platinum sponge and it was found that the discharge was much more constant under a pressure of 50 atmospheres and over, up to 600; the efficiency of this apparatus as an accumulator was very high if the discharge follows the charge immediately, and it attained 95 to 98 per cent. (presumably in ampere-hours); the negative electrode must weigh three times as much as the positive, and under these conditions a capacity of 25 ampere-hours per pound of platinum was obtained, the current when constant was about 45 amperes per pound. Iridium gave similar results; ruthenium was slightly attacked; with palladium in the form of a sponge the capacity under pressure was 80 ampere-hours per pound, the positive electrode weighing twice as much as the negative; palladium absorbs 2,400 times its volume of hydrogen, or 600 volumes of oxygen; with gold sponge the results were similar to those with platinum; with the baser metals, including silver, and with carbon, the actions were different and it was found that there was a chemical action; they conclude that only the precious metals can be used for such accumulators and that therefore this method does not admit of practical application.

Million Battery.—"L'Elec.," Nov. 10, gives some data regarding this battery, in which the zinc is placed in an annular porous cup, containing sulphuric acid and the carbon plate is formed of rods, some of which surround the porous cup and others are surrounded by it, the zinc being therefore active on both sides; the depolarising solution is made of bichromate of soda in acidulated water. The E. M. F. on open circuit is 2.1 volts, with 10 amperes 1.8 volts, and it will give 100 amperes on short circuit; it has a capacity of 160 to 180 ampere-hours (the size of the element, however, is not given); five cells will run 20 lamps (candle-power not given) for five hours, the charge for which costs 10 cents per cell, including the zinc consumed; a few further figures are given for a small portable cell and for charging accumulators; it is stated that a tricycle operated by 8 cells can be run for 48 miles at a cost of 80 cents.

Leclanche Cells.—According to "L'Eclairage Elec.," Nov. 3, Mr. Mechinel states that if the white deposit formed in Leclanche cells is boiled in double its volume of water, oxide of zinc of commercial value will be formed.

Bleaching Paper Pulp.—A new process by Mr. Abom is briefly described in the Lond. "Elec. Rev.," Nov. 16. The pulp is placed in a receptacle not attacked by chlorine and a solution of an alkaline chloride is added, after which a current is passed through it between carbon plates; after 20 to 40 minutes the current is stopped and the bleaching continues to any desired extent; care must be taken that the temperature does not rise too high or the hypochlorite will be converted into chlorate which possesses no bleaching properties.

Maximum E. M. E. for Electrolysis.—The Lond. "Elec. Rev.," Nov. 16, calls attention to a paper by Mr. Wiedeberg from the "Zeit. feur Chem.," vol. 14, page 174, the results of which practically negative the question of maximum E. M. F. in electrolysis; the author believes that for any given E. M. F. there is a certain corresponding pressure of the gaseous product, the formula for which is given, and therefore electrolysis is set up by ny E. M. F. however small.

Limits of Electrolysis.—The paper by Mr. Berthelot from the "Ann. de Chim. Phys.," September, 1894, is abstracted in "L'Eclairage Elec.," Nov. 3; he shows the agreement between measurements by different observers with entirely different methods, thus giving a striking experimental confirmation.

MISCELLANEOUS.

Elevator.—An illustrated description of an electric elevator used in Berlin, is published in the "Elek. Zeit.," Nov. 15; the drum is operated by a worm wheel driven by a 5-hp motor; it is intended to carry 1,100 lbs. with a speed of about 20 ins. per second; it includes an arrangement by which a brake is put into action automatically when the current is broken.

Practical Application of Ozone.—The paper by Dr. Froelich abstracted in the Digest, Nov. 17, is published in full in the Report of the German Electro-chemical Society.

Ruhmkorff.—A discussion of the spelling of this name has appeared in the Lond. "Elec.," and in the issue of Nov. 16 several correspondents show that in the original articles it is spelt "Ruhmkorff," thus leaving no doubt as to the correctness.

Electromagnetic Governor.—The Decombe system is described and illustrated in "L'Elec.," Nov. 10; the valve is opened mechanically but is closed by the electric device.

Alarm.—An apparatus to be connected with doors, cabinets, windows etc., to ring an alarm when opened, is described and illustrated in the "Zeit. feur Elek.," Nov. 1.

Alarm Clock.—An apparatus adapted to be attached to any clock, to ring an electric alarm at any predetermined time, is described in the "Zeit. feur Elek.," Nov. 1.

Antwerp Exhibition.—A descriptive article by Mr. Brunswick is published in "L'Eclairage Elec.," Oct. 27; it appears that the department "Electricity" was not very well represented; two large illustrations of three cylinder electric pumps are given; he states that the failure of the trolley balloon was not due to a failure in the electrical apparatus.

Biographical.—A biography of Helmholtz of some length, is published in the "Elek. Zeit.," Nov. 8.

New Book.

Tramways: Their Construction and Workings. By D. Kinnear Clark. New York: D. Van Nostrand Co. 758 pages, 405 illustrations. Price, $9.00.

The note book of the experienced engineer, while containing valuable data, is in general a history of his work and the mistakes he has made. It is seldom that he uses the data without some modification or improvement. The work on tramways by D. Kinnear Clark is essentially such a note book, and by its history of what has been done it furnishes the data necessary to determine what to do. It is not a book describing methods of procedure and recommending different materials. It is rather a book of facts and figures on actual tramways, presented with but little comment. The data speak for themselves and the reader is left to draw his own inference. The book is divided into seven parts and an appendix.

Part 1 is a history of the origin and progress of tramways. While interesting as general reading it has a certain value in its collection of old ideas. The careful consideration of a collection of old ideas is one of the most fruitful sources of new ones.

The value of Part 2 is unquestionable. It is a collection of statistics of great value both to the stockholder and engineer. As Mr. Clark states in his preface the statistics are largely taken from the business records of the officials of the tramways mentioned, and, therefore, it would be hard to question them. So many examples are given that it is possible for the engineer to pick out one to fit his particular case. Among the data given are some not often found on managers' records, but none the less interesting. Almost any record will give net receipts and expenditures, fewer give mileage of cars and passengers carried, and it is seldom that a person is able to run across data on rates, taxes, tolls, compensation for personal injury, legal and parliamentary expenses, etc., and this too in the neighborhood of several hundred different cases. The classified tables of expenses per car per motor or per horse are very interesting. The fact that the most trivial items are listed and not blocked together under sundries, is evidence of the completeness of the data. This part is particularly interesting to stockholders and managers.

Part 3 takes up the construction of tramways. Illustrations of cross-sections of tramways and rails are frequent, and tables of cost per mile, not simply for the whole construction, but for excavating, filling, paving, ties, rails, spikes, bolts and tie plates. There are also given specifications for material, tests and prices of supplies, of excavating, filling and concreting per cubic yard from the schedule prices of contracts. The laying of tracks is described in detail. The method of mixing and composition of cements and concretes used, also the operations in their order. The drawings and cuts are to a given definite scale, which adds greatly to their value. This part comprises 242 pages, which gives an idea of its completeness.

Part 4 is devoted to tramway cars. Starting with the historical, it gives descriptions and working drawings of car bodies, trucks and suspensions. The inventor and designer will find them of great value, and a careful perusal of the drawings of suspensions, and trucks, would result in the design of a better street railway truck than is in general use to-day. To design a new truck is easy, but to design a good truck is more difficult, and it is as important to know what to avoid as what to construct. Such information can only be obtained by careful perusal of existing forms and their performance, and these data are given in this book.

Part 5 is devoted to mechanical power on tramways. It is noticeable that here, as all through the book, where a fact is to be established or a principle demonstrated, the author turns not to a mathematical proof or theoretical deductions, but to the data on a practical existing case. Not simply steam-power but compressed air and cable traction are discussed, accompanied by copious tales of data, drawings and illustrations.

Part 6 discusses electric traction and has great historical value, and shows how step by step the progress has advanced. Expert tests of actual roads are given, and reveal where the power goes to and in a measure why it goes there. The data and descriptions are always exhaustive. Pole and line construction is discussed and data which is difficult to obtain, but none the less important, is included in the tables given.

Part 7 comprises supplementary chapters on special motors, namely: oil and gas. Data with regard to these motors is exceptionally difficult to obtain. The appendix comprises parliamentary and official regulations, and is useful to the promoter as giving the legal obstacles he is likely to meet.

The whole book has a value to any one interested in tramways, and is a useful addition to the library of the engineer, capitalist or promoter.

A New Car Controller.

A new car controller has been perfected by Edward F. Edgecumbe, 60 Elm street, Lynn, Mass., which, it is claimed, is in many respects quite a departure from present practice and a step in advance. Among its features are a quick break of contacts, and the current carrying parts liable to arc are immersed in an oil bath. The operating handle also puts on an electric brake when desired, but this cannot be put on until the current is shut off. The reversing switch is interlocking so that it cannot be changed while the current is on. The motors and the main operating handle cannot be moved forward until the reversing switch is in proper condition. It is also claimed to be much smaller and lighter than the controllers now in use, thus cutting down the dead weight on electric cars which is so damaging to the present road-beds. Its working parts all operating in a medium of high resistance renders it safe from arcs, burns, and cutting by dust. Its inventor, Mr. E. F. Edgecumbe, of Lynn, Mass., was in charge of the assembly and testing of the E and K controllers, made by the General Electric Company, from their beginning until last July, and claims that this new controller will more than meet the work required of it.

Electric Clocks.

We illustrate a very useful improvement in self-winding clocks, the invention of Mr. Adam Lungen, of the firm of Edwards & Co., of New York. Being a practical clock maker, he has overcome the difficulties and objections formerly found in self-winding clocks.

The following are the cuts of but two of the many improvements which they manufacture for different requirements: No. 1 is a primary self-winding movement, being wound up every 15 minutes by a single instantaneous contact, the power required being furnished from only three cells of carbon cylinder battery.

By the special construction of the magnets the draught is equalized, a uniform tension is applied to the train by a simple spiral spring, the strength of which can be regulated; the contacts being made and broken

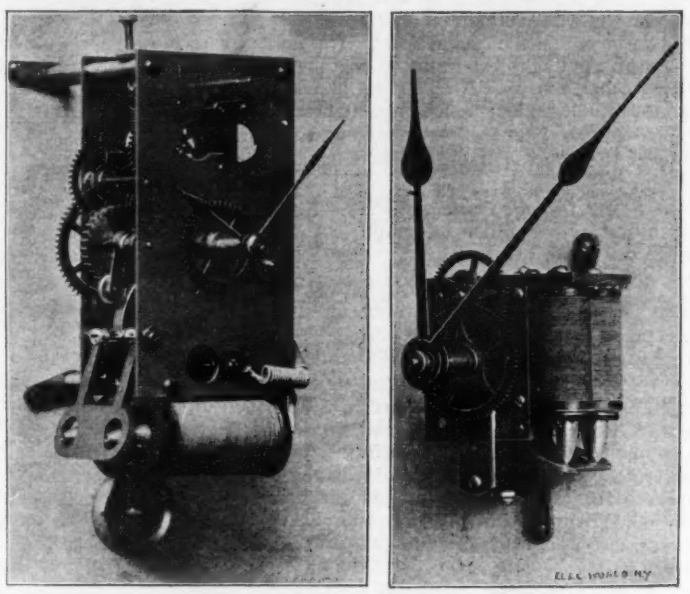


Fig. 1 and 2.—Electric Clocks.

rapidly, and then only once in 15 minutes, the battery will last an indefinite length of time.

Each movement is arranged to prevent all sparking at the platinum contact points, and is made with either long or short pendulum, and is simple, strong and mechanical in construction.

No. 2 is a secondary movement or minute jumper, constructed on similar principles to the No. 1 or primary clock.

The armature has a long draught, and moves the hands while being attracted, not being jerked forward, but with a regular motion.

It is locked at every movement, so that its uniform acting cannot be interfered with.

As many secondary movements as may be required can be operated from one primary clock.

Mileage of Electric Railways in Europe.

A German engineer has recently investigated all the important electric tramways in Germany, France, Italy, and Swizerland, and the following extract gives the mileage in different European countries at the close of 1893:

	In operation.	In construction.	Total.
Belgium	3.2	18.5	21.7
Germany	102.0	66.1	168.1
England	71.4	21.4	92.8
France	41.4	29.0	70.4
Italy	13.0	—	13.0
Holland	4.9	—	4.9
Austria-Hungaria	33.4	—	33.4
Roumania	—	5.5	5.5
Russia	3.0	7.0	10.0
Sweden and Norway	—	6.5	6.5
Switzerland	23.6	1.6	34.2
Servia	—	10.0	10.0
Spain	14.0	—	14.0
Total	309.9	174.6	484.5

Financial Intelligence.

THE ELECTRICAL STOCK MARKET

NEW YORK, Dec. 1, 1894.

THE ELECTRICAL STOCK MARKET finds itself in that state of comparative inactivity generally marking the course of stocks toward the end of the month. The indisposition to trade is aggravated by the Thansgiving holiday followed as it is by but a day and a half of actual trading and the Stock Exchange district is pervaded this week by an air of gloom. Quotations accordingly tend downwards though in most instances more in sympathy with the current gloom than in accordance with special reasons.

GENERAL ELECTRIC'S reactionary tendency illustrates the trend of the market. All the news and gossip relative to the stock developing this week has been in the stock's favor, yet quotations fail to develop strength, in fact at times marked weakeness is demonstrated. It would seem that the bear clique was not in much need of ammunition to further their campaign as prices continue to fluctuate in accordance with their wishes. None the less, they have endeavored to influence the stock's course by circulating stories regarding the company's labor policy. The true state of affairs is that the General Electric Company has changed its labor system, not by cutting wages 10 per cent. as reported, but by increasing the number of hands employed by the piece, a step that is bound to prove a source of economy to the company. The financial side of the company's affairs continues as satisfactory as last reported. Receipts are reported as still exceeding expenditures, and the General Electric Company has now nearly $600,000 in cash on hand besides the $250,000 cash deposited to m t the next semi-annual interest payment on its bonded indebtedness. Besides this amount in cash the company has also in its treasury $1,000,000 of its 5 per cent. bonds, which it purchased at an aggregate cost of about $870,000. Excepting one for $2,126 which it has been unable to get in, the company has no notes outstanding; the only other indirect indebtedness it is liable for are two old guarantees agregating $130,279, which guarantees, it is stated, it may never be called upon to make good.

STANDARD UNDERGROUND CABLE stock, one of the Westinghouse group, has dropped to 90 bid by reason of some litigation in which 20,000 shares of the stock are involved. The intrinsic value of the stock is not affected, however; in fact recent developments in the company, as related in a former issue, have tended to make it more worth possessing than ever.

AMERICAN BELL TELEPHONE stock has been a little affected by the issue of the circular offering to shareholders 5,000 new shares at 190, payable Jan. 5, 1895, when certificates will be ready for delivery. According to the official circular, each stockholder of record Nov. 15, 1894, is entitled to take shares of the new stock in proportion of one share for every forty shares then held. The right to subscribe expires at 2 o'clock on Dec. 22, 1894; no interest, however, will be allowed upon sums paid in advance. All stock not subscribed for by shareholders will be sold at auction. According to Boston advices, there is quite a division among large Bell telephone stockholders as to the wisdom of this measure. Quite a party in the company is in favor of issuing bonds rather than selling stock under the act of the Legislature, but the management has determined to give it a fair trial, future policy to be determined by the out come of the present issue. The business of the company, as reflected by the instrument output record, is beginning to look up. For the month ending November 20 the net output was 3,313 instruments, a gain over last year, when more telephones were returned than put out, of 5,870. Since December 20, 1893, the gross output has been 81,021 instruments; 65 630 have been returned, so that the net output was 15,391, a loss of 1,823 as compared with a similar period of 1893.

ELECTRIC STORAGE stock has had a boom this week, and many New Yorkers, who hold quite a deal of its $12,000,000 capital stock, are very much gratified. The believers in the property are very enthusiastic regarding its future, claiming that the storage battery manufactured under the company's patents will prove as valuable an enterprise as Bell telephones has in the past.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	98	99
" " " Brooklyn	100	109	112
" " " Boston	100	127	128
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage	—	37	38
Electric Construction & Supply Co., com.	15	7⅛	10
" " " pref.	15	7½	10
Fort Wayne Electric	100	2	3
General Electric	100	34½	35
General Electric, pref	100	68	70
Westinghouse Consolidated, com.	50	34	35
" " " pref	50	51	52½

BONDS.

Edison Electric Ill., New York	1,000	107¾	107¾
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	90	91

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	195	196
American District Telegraph	100	40	45
American Telegraph & Cable	100	88	91
Central & South American Telegraph	100	102	105
Commercial Cables	100	125	145
Erie Telephone	100	51⅛	52
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
New England Telephone	100	67	69
New York & New Jersey Telephone	—	97	98
Postal Telegraph-Cable	100	50	55
Western Union Telegraph Ex-div.	100	86⅛	87

WESTINGHOUSE ELECTRIC issues continue quiet. The coming dividend on the preferred stock plays no part in the transactions on the stock exchanges where it is traded in; it will be regular and its value has already been discounted. A feature of the Pittsburg market in the early days of the week was the advance of $1 in the bid price for the company's scrip. There is quite an investment demand for this security. The work of removing the plant to the new works is rapidly accomplished; the completion of the transfer is only a matter of a few weeks at the utmost, when the beginning of manufacture under the new and economical processes estabished in the Branton plant will be an assured fact.

ERIE TELEGRAPH AND TELEHPONE stock has not been very lively of late; none the less quotations hold their own. The company made a net gain of 132 subscribers in October, making the total connected October 31 amounting to 15,932.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES' trustees have further set aside $47,000 to buy in preferred shares, bids being received until next Monday. So far 17,693 shares in all have been purchased and cancelled.

WESTERN UNION TELEGAPH remains heavy. Another large short interest has been developed, but what with the scant[illegible] stock, it may find it unable to cover contracts at current prices

THE ELECTRIC TRACTION STOCK does not develop any further speculative tendencies. None the less there is a noteworthy demand from investment sources, the current low money rates combined with the plethora of funds serving to keep this demand healthy and active. The growth of the traction companies and the part they are beginning to play in the financial world are attracting more and more the attention of the investing public. Many of these companies are capitalized at from $10,000,000 to $30,000,000, and as, when well managed and not over capitalized, they have shown a surprising ability to make money at a rate less liable to variation than is the case with most other enterprises, they have proved themselves corporations whose issues are worth the serious attention of investors. Interest in this class of securities is, therefore, growing daily. Philadelphia notes that the market for street railway bonds and stocks is growing fast, brokers finding it more and more difficult to execute orders by reason of the small floating supply of these securities. New Yorkers are also interesting themselves in street railway projects further west, as Pittsburg has a story that easterners are in a syndicate to buy a controlling interest in the Pittsburg & Birmingham Traction Company, whose stock is quoted around 30. It is also thought that New Yorkers are back of the Chicago General Railway, which is to spend almost immediately $10,000,000 in building trolley roads in West Chicago street railroad territory.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	130	136
Brooklyn Traction pfd.	65	68
" " common	15	16
Long Island Traction	13¾	14
Rochester St. Ry	40	41
Columbus St. Ry	45	50
Louisville St. Ry. pfd	87	88
" " " common	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	56	58
North Shore Traction	22	—
New Orleans Traction	59½	—
Worcester Traction pfd	82	86
" " common	14½	16
Metropolitan Traction Philadelphia	106	107
Philadelphia Traction	101⅛	102
People's Traction	55	55⅛

BONDS.

	Bid	Asked
*Union Ry. 1st. mtge 6s	105	108
*Westchester Electric 1st. m. 5s	98	101
Rochester St. Ry. 1st. 5s	95	97
*Columbus St. Ry. 1st 5s	89	92
Columbus Crosstown 1st. 5s	95	97

*With accrued interest.

NEW INCORPORATIONS.

THE VAN WERT TELEPHONE COMPANY, Van Wert, O., capital stock $10,000, has been incorporated.

THE MT. VERNON AND WALHONDING ELECTRIC RAILWAY, Mt. Vernon, O., capital stock $50,000, has been incorporated by F. T. Botgarn and others.

THE RATON GAS & RAILWAY COMPANY, Santa Fe, N. M., has been incorporated by Frederick Mitchell, Jeremiah Leahy, Alva L. Dobbs, Perry H. Smith and Leslie St. John.

THE CONNERSVILLE GAS & ELECTRIC COMPANY, Connersville, Ind., capital stock $150,000, has been incorporated. H. W. Miller, C. F. Mosier and George W. Combs are interested.

THE MERCHANTS' ELECTRIC COMPANY, Marceline, Mo., capital stock $6,000, has been formed to do electric lighting. Geo. W. Early, W. A. Cates and W. A. Cannon, Marceline, are the promoters.

THE NOKOMIS ELECTRIC LIGHT & POWER COMPANY, Nokomis, Ill., capital stock $10,000, has been formed to furnish electric light, etc. The promoters are R. E. Cornelius, George Bliss and Garrett Carstens.

THE CLARKSBURG AND SUBURBAN STREET RAILWAY COMPANY, Clarksburg, W. Va., has been incorporated by R. S. Gardner, J. H. Horner and others to build an electric road in the city. It has a 25-year franchise.

THE POTOMAC LIGHT & POWER COMPANY, Georgetown, D. C., capital stock $35,000, has been incorporated by A. H. Wilder and V. M. Watkins, of St. Paul, Minn., and George A. King and W. E. Harvey, of Washington.

THE STANDARD ELECTRIC COMPANY, Philadelphia, Pa., capital stock $1,000, has been formed to supply light, heat and power. The organizers are Jos. A. Goodfellow, Thos. M. Carlin and Irvin S. Deakyne. Philadelphia, Pa.

THE UNION ELECTRIC COMPANY, Halstead, Pa., has been incorporated with a capital stock of $150,000, by J. Gardner Cassatt, Thos. A. Biddle & Company, Robt. Mitchell, L. B. Huff, Thomas Donohue, Wm. F. Lloyd and John Lloyd.

THE LIBERTY TRACTION STREET RAILWAY COMPANY, Pittsburg, Pa.

capital stock $70,000, has been formed to construct, maintain and operate a street railway. John F. Scott, W. F. Bickel and Augustus Hartje, Pittsburg, are interested.

THE TACOMA TRACTION COMPANY, Tacoma, Wash., capital stock $500,000, has been formed to construct and operate street and other railways, build sidewalks, etc. Stuart Rice, Geo. B. Blanchard and Chas. S. Fogg are the organizers.

THE TRADERS' ANNEX COMPANY, Clarksburg, W. Va., capital stock $1.000,000, has been formed to construct electric plants, street railways, erect and own buildings, etc. The incorporators are T. M. Jackson, D. R. Morgan and W. B. Maxwell.

THE WATERLOO, SENECA FALLS & CAYUGA LAKE RAILWAY COMPANY has been incorporated with a capital stock of $150,000, to build and operate a surface electric road for four miles from Seneca Falls to Orchard Beach, on Cayuga Lake.

THE CARTHAGE, WEBB CITY, JOPLIN AND GALENA ELECTRIC RAILWAY COMPANY, St. Louis, Mo., capital stock $175,000, has been incorporated. John J. Taussig, David R. Powell, St. Louis, Mo., and Chas. C. Carroll, Springfield, Ill., are interested.

THE SEDALIA AND BROWN SPRINGS ELECTRIC RAILWAY COMPANY, Sedalia, Mo., capital stock $80,000, has been formed to build and operate an electric railway. D. C. Metsker, Chas. Carroll, Sedalia, Mo., and W. E. Sterne, Topeka, Kas., are interested.

THE JAMAICA CONSTRUCTION COMPANY, Haddonfield, N.J., capital stock $100,000, has been formed to build, construct and equip electric railways. Edw. Ilsley, Walter C. Smith, Philadelphia, Pa., and John McNeill, Haddonfield, N. J., are the interested parties.

THE SHORE ELECTRIC COMPANY, Red Bank, N. J., capital stock $100,000, has been formed to manufacture and generate electricity for light, heat and power, etc. Fred. W. Ward, East Orange; Harry P. Chandler, Newark, and Percy Ingalls, Verona, N. J., are interested.

THE S-K-C SPECIALTY COMPANY, Pittsfield, Mass., capital stock $12,500, has been incorporated to manufacture and sell machines, apparatus, tools, electrical appliances and novelties. The interested parties are R. de W. Sampson, Wm. Gardner, John F. Kelly and C. C. Chesney.

THE TOLTEC COAL COMPANY, Denver, Col., capital stock $50,000, has been incorporated to buy, sell and work coal lands, and to construct and operate an electric railway in connection with same. Pliny F. Sharp, John McNeill and Paul Lanius, all of Denver, are the incorporators.

THE SUBURBAN LIGHT & WATER COMPANY, Wheeling, W. Va., maximum capital stock $500,000, has been formed to establish and maintain water works and an electric light, heat and power plant. August Ralf, Anton Reymann and Paul O. Reymann, Wheeling, W. Va., are the organizers.

THE CARDINGTON ELECTRIC LIGHT & POWER COMPANY, Cardington, O., capital stock $15,000, has been incorporated to build, own and operate an electric light and power plant, etc. M. J. Carmack, Evan T. Bown, T. J. Carmack, . H. Fishack and H. F. Fishack are the promoters.

THE GOLDFIELD WATER, GAS, ELECTRIC LIGHT AND POWER COMPANY, Denver, Col., capital stock $100,000, has been formed to construct and operate a plant for furnishing water, gas and electric lights to Goldfield. Peter J. Fredrich, Alois Koch and John L. Frazer, all of Denver, are interested.

THE LULING ELECTRIC LIGHT AND POWER COMPANY, Luling, Texas, capital stock $20,000, has been formed to furnish the city of Luling with electric light and power, and to buy and sell electrical supplies. W. R. Johnson, David Gregg, F. R. Starr, Jr., and H. Kleinsmith, all of Luling, are interested parties

THE DYNAMO-ELECTRIC MAINTENANCE COMPANY, Hoboken, N. J., capital stock $500,000, has been formed to make contracts, maintain electric dynamos, motors, wires, fittings and appliances. The organizers are Geo. F. Dinsmore, Robt. S. Ashe, Boston, Mass., and Leon Abbott, Jr., Hoboken, N. J.

NATIONAL ELECTRICAL REMINDER COMPANY, Chicago, Ill., capital stock $250,000, has been incorporated to manufacture, sell and deal in electrical devices, appliances, instruments, etc., buy and sell patent rights. Siegfried Rosenfield, Augustus Rosenfield, and David C. Thomas are interested.

THE MOORE ELECTRICAL COMPANY, New York, capital stock $50,000, has been formed to manufacture and sell electric lamp vibrator regulators, and other electrical contrivances. Jos. Livingston, Leopold Wallach, D. McF. Moore, New York City, and E. J. Wessels, East Orange, N. J., are the organizers.

THE PORTLAND AND YARMOUTH ELECTRIC RAILWAY COMPANY, Portland, Me. capital stock $200,000, has been formed to build and operate an electric tramway between Portland and Yarmouth. Edward S. Perry, John S. Bradley, New Haven, and Jas. O. May, Naugatuck, Conn., are interested parties.

THE NORTH AMERICAN INTERIOR TELEPHONE COMPANY OF BALTIMORE CITY, Baltimore, Md., capital stock $60,000, has been formed to manufacture telephones and telephone appliances, electric switches and other electrical machinery. The promoters are Fred. W. Schulz, I. Kemp Bartlett, Jr., Seneca P. Broomal, Chas. G. Hughes and Thomas R. Brimner.

THE STOCKTON GAS AND ELECTRIC COMPANY, San Francisco, Cal., capital stock $1,000,000, has been formed to generate electricity and supply same for light, heat and power; also to manufacture gas, operate and deal in water rights, works, etc. August Muenter, Stockton, Cal.; W. B. Kollmyer, Chas. C. Green, San Francisco; Edward Barry, Oakland; F. W. Longee, Robert M. Welch, and Edward R. Taylor, San Francisco, Cal., are the incorporators.

Special Correspondence.

New York Notes.

Office of The Electrical World,
253 Broadway, New York, Dec. 3, 1894.

MR. GEO. P. FLYNN, late manager of the New York office of the Campbell & Zell Company, of Baltimore, Md., has severed his connection with that firm.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., has recently opened an Eastern office in the Havemeyer Building, New York, which will be in charge of Mr. C. I. Hills.

J. S. DUVAL, formerly manager of the New York office of the Ball Engine Company, has severed his connection with this company and engaged himself with Mr. F. R. Chinnock, electrical contractor, 143 Liberty street, N. Y., as office manager.

MR. FRANK X. CICOTT, manager of the railway department of the Pettingell-Andrews Company, Boston, sailed for Europe on the Lucania December 1, in connection with the girder rail business of his house and Messrs. Dick, Kerr & Company, Ltd.

THE SERIAL BUILDING LOAN AND SAVINGS INSTITUTION, of New York City, which was at first composed almost exclusively of telegraphers, was the pioneer of the movement in this line in New York City, where it has now attained huge proportions. The officers of this association on November 15 began the publication of a monthly called the "Serial News," for the purpose of keeping its members fully informed as to the developments in building association matters which affect their interests.

Western Notes.

Branch Office of The Electrical World,
936 Monadnock Building, Chicago,
December 1, 1894.

THE JENNEY ELECTRIC MOTOR COMPANY, Indianapolis, is now issuing attractive bulletins setting forth all the good points of its apparatus.

THE ELLIOTT-LINCOLN COMPANY, of Cleveland, O., finds orders coming its way all the time. Its new style of motor is deservedly popular.

THE WEBSTER MANUFACTURING COMPANY is now giving especial attention to the "Lewis" gas engine for electrical work, and reports business as quite brisk. This engine has been on the market for some time, and is at present in service in scores of places driving dynamos.

W. B. AUSTIN has been appointed Western selling agent for the Safety Insulated Wire and Cable Company, of New York, and will make his headquarters in the Monadnock. Mr. Austin was for six years with the Western Electric Company, and for two years with the Knapp Electrical Works. He is one of the most popular salesmen in the West.

THE ELECTRIC RAILWAY EQUIPMENT COMPANY, of Cincinnati, O., reports from that town business as rapidly mending. One of its new designs of poles has been adopted by the city for its parks and viaducts. It will shortly place on the market many new and highly ornamental types of electric light and street railway poles. It is now ready to furnish information.

THE EVER POPULAR WABASH RAILROAD, inaugurated on November 1 a system of through tourist sleepers from Chicago to San Francisco, via St. Louis and the Iron Mountain, Texas & Pacific and Southern Pacific Railroads, to leave Chicago daily on the fast express at 10.50 a. m. Full particulars can be obtained at 201 Clark street.

THE GREAT WESTERN MANUFACTURING COMPANY has practically closed out, having sold all its Chicago assets to the First National Bank. There is no chance of resuming. While the condition of this company for some time has been precarious, the collapse was a surprise, as they have been announcing to all their creditors for the past several days that they would at an early date have the necessary means to settle all outstanding obligations, and are now claiming that it was because of Boston people failing to send them promised funds on their recent bond issue, that they are unable to keep this agreement. It is said that the creditors will not be able to realize one cent on the dollar.

Canadian Notes.

Ottawa, Dec. 1, 1894.

AYLMER, QUEBEC.—R. Anderson has installed over 2,000 incandescent lights in this little town.

TORONTO.—A report is current that H. A. Everett, of Cleveland, has resigned the vice-presidency of the Toronto Street Railway Company.

VANCOUVER, B. C.—The electric street railway and lighting system of Vancouver., B. C., has been sold to an English company for $350,000.

MIDLAND ONT.—Application has been made to the Ontario government for a charter by the Midland Electric Light & Power Company. Capital $10,000.

HAMILTON, ONT.—The Hamilton Radial Railway Company asks the city for a bonus of $400,000, in return for which paid up stock to an equal amount is offered.

MONTREAL.—A prospectus has been issued in the London (England) market, inviting subscriptions for £120,000 worth of 4½ per cent. debentures of the Royal Electric Company, of Montreal.

MONTREAL.—The earnings of the Montreal Street Railway Company for October amounted to $88,023 for the month, the average per day being $2,839. The increase for the month, as compared with last October, was $15,580.

TORONTO.—The Magnanetawan Tanning and Electric Company, with a capital of $50,000, has received a charter from the Ontario government, among other things for the purpose of supplying electricity for lighting and heating purposes.

MONTREAL.—At a meeting of the shareholders of the Royal Electric Light Company, the new issue of $750,000 debentures was approved. These are the bonds which D. Morrice was instrumental in floating during his recent trip to England.

TORONTO.—An application has been made by the Toronto & Suburban Railway for a franchise for the extension of its system westward to Lambton and Islington along Dundas street. If the application is successful work will be started immediately.

OSHAWA, ONT.—The agreement for the construction of an electric street railway has been again submitted to the City Council, and on a vote of 8 to 7 was revived. W. E. Rathbun, of Deseronto, deposited bonds for the completion of the road by the time specified.

ONTARIO.—Two electric railway schemes are now under consideration in Northern Ontario. One for running a line from Owen Sound to Kincardine

and the other from Parry Sound to Ahmic Harbor, both lines to obtain their power from neighboring waterfalls.

VANCOUVER, B. C.—Rumors that the property of the Vancouver (B. C.) Street Railway & Electric Lighting Company have been sold to an English syndicate are confirmed. All employees have received notice of dismissal, as the new company intends to completely reorganize the staff.

HULL, QUEBEC.—Mr. G. Viau, chief promoter of the new electric railway scheme in Hull, stated on Thursday that his company had not been dickering with the Aylmer Road Company. He thought that at the next meeting of the shareholders a proposition might be laid before them to either sell out to the new electric company or grant right-of-way.

OTTAWA, ONT.—A joint stock company has been formed with a capital of $45,000, for the manufacture in this city of primary electric batteries under the patent of C. J. Hubbell, of Washington, D. C. The new carbon and porcelain factory to be built in this city is to be in operation on the 1st of May. It will employ 100 hands. A Peterboro man has been engaged to take charge of the factory.

OTTAWA, ONT.—From Ottawa to Aylmer by electric cars by way of Hintonburg, Shad's Mills and Britannia, crossing the Ottawa River at Deschene Rapids on a bridge that is to cost $150,000, is the move the Canadian Pacific Railway and the Ottawa Electric Railway have combined in. H. B. Spencer, assistant superintendent of the Canadian Pacific Railway, and Mr. Ahearn, manager of the Ottawa Electric Railway, admitted that the scheme was under contemplation and would be begun soon.

HAMILTON, ONT.—One of the most extensive electric railway schemes yet contemplated in Canada is the Hamilton Radial Electric Railway. The intention is to build a network of railroads, steam and electric, radiating from Hamilton and connecting with the more important cities and towns of Western Ontario. It is intended to build a first-class road and connect at Woodstock, Toronto and other points with the Canadian Pacific Railway. The electric part of the system will likely be the lines to Berlin and Guelph, and on these the road bed and gradients will be fully up to the first-class steam railway requirements. The Niagara Falls branch will be continued to Buffalo.

ST. HYACINTHE, QUEBEC.—The St. Hyacinthe Gas Company, who claimed the sole right to light this city for twelve years, has lost its suit against the St. Hyacinthe Hydraulic Power Company, which is arranging to supply the city with electric light. The latter company has made very extensive improvements in order to increase the power, having made above the dam a canal 600 feet long and 45 feet wide, and below the dam 1,280 feet long by 80 feet in width, all through solid rock, the fall being 17 feet 10 inches. This will probably give them 1,100-hp to dispose of. It will, however, only require about 250-hp to keep the city supplied with light. They have 2,000 lamps placed in the city, and the charge is not to exceed $3 a lamp.

OTTAWA.—The Electric Street Railway Company has decided to issue $187,000 new stock. The present paid-up capital of the company is $625,000. The new stock will make the paid up capital $813,300. The additional money is needed partly to clean off floating liabilities, partly to defray the cost of probable extensions of the system. The present stock has been changing hands, at $165 to $180 per share of $100. From June, 1891, to June, 1892, the first year of operation, the company carried 220,000 passengers and paid 7 per cent. dividend. From 1892-93 the company carried 2,394,000 passengers and paid 8 per cent. For 1893-94 the company carried 2,700,000 passengers and paid 8 per cent. For the present year so far the number of fares has greatly increased.

News of the Week.

TELEGRAPH AND TELEPHONE.

WAYNESVILLE, N. C.—J. E. Hellema contemplates constructing a telephone system.

SUMPTER, S. C.—The Mason Telephone Company will enlarge its plant and put in additional machinery.

ATLANTA, GA.—The Athens Telephone Exchange, H. C. Conway, manager, is to construct a line from Atlanta to Athens.

COUNCIL BLUFFS, IA.—The Nebraska Telephone Exchange is putting in new wires and otherwise improving its service.

MANISTEE, MICH.—A long distance telephone line is to be constructed and the poles are being placed between Manistee and Ludington.

AUSTIN, TEX.—The National Telephone Company and the Anthony Telephone Company have been granted franchises by the city council.

BOSTON, MASS.—Commissioner of Corporations Endicott has decided that the new issue of Bell Telephone stock, 5,000 shares, may be sold at $190 per share.

SPRINGFIELD, MASS.—The New England Telephone Company is negotiating with the West River Company for the purchase of its plant from Townshend to Stratton.

AUSTIN, TEX.—The National Telephone Construction Company is applying to the City Council for a telephone system. J. M. Lindsay, C. R. Smith and others are interested.

DUNKIRK, N. Y.—The proposition which the Phoenix Telephone Company makes to Dunkirk is that if the people there will subscribe to $4,000 stock, the Phoenix Company will erect the plant, which will cost about $11,000.

NEW YORK.—A new telephone company has been organized with the following incorporators: Chas. Oliver, H. B. Rollison, Wm. Howard, Wm. Chamberlain, Ferdinand Thompson and W. J. Lansley. The object of the company is to supply local telephone service to Rahway, N. J., at low rates.

ST. LOUIS, MO.—A new telephone company is to be incorporated under the laws of Missouri with a capital of $1,000,000, and will give, it is claimed, cheaper telephone service than the Bell company. The patent is owned by the Chicago Interior Telephone Company, which is now applying for a franchise to put in its wires in Chicago. The cost, it is said, will be $2 per month, and the telephone will be operated by dropping a nickel in the slot.

ELECTRIC LIGHT AND POWER.

WOODBINE, N. J.—An electric light plant is soon to be established.

BREMEN, IND.—An electric light plant costing $48,000 is to be established at Bremen.

ROCKVILLE CENTER, N. Y.—The question of lighting the streets is being agitated.

LEWISTOWN, ME.—The plans for the municipal electric plant have been settled on.

APPALACHICOLA, FLA.—Address the Mayor concerning contemplated electric light plant.

GADSDEN, ALA.—The Queen City Electric Light Company will double the capacity of its plant.

CAPE MAY, N. J.—A committee was authorized by the Council to inquire into the cost of an electric light plant.

MALVERN, ARK.—The contract for lighting the city has been let and the plant is to be completed by January 1.

TIFFIN, O.—The Tiffin Electric Light Company is making arrangements to largely increase the capacity of its plant.

ESSEX, CONN.—A number of men in Essex are agitating the scheme of organizing a company to light the place by electricity.

HACKENSACK, N. J.—The Edison Electric Light Company's plant which was recently burned, is to be rebuilt at a cost of $30,000.

EDWARDSDALE, PA.—An election will be held February next to decide the question of lighting the streets of the borough of Edwardsville.

WHEATON, ILL.—The Wheaton Electric Light & Water Company, Wheaton, certified to an increase in capital stock from $15,000 to $22,000.

NEWTOWN, N. Y.—The Town Board proposes to lay out a lighting district which will include Grand street, and then advertise for bids.

SAFE HARBOR, PA.—The change at the Safe Harbor Iron Works to convert the old building into a match factory will include an electric plant.

BROWNSVILLE, TEX.—John R. Bond, Jas. A. Brewer and John Clinton have been granted a franchise for the erection and operation of an electric light plant.

RALEIGH, N. C.—The Raleigh Electric Company, which has been organized with A. A. Thompson as president, will put in a complete plant for incandescent lighting.

SYRACUSE, N. Y.—A petition will be presented to the Common Council by the Citizens' Electric Company, which is asking for an electrical franchise for this city.

CLEVELAND, O.—The Ohio and Pennsylvania Coal Mining Company has contracted to equip its Cedar Hill mines with electric mining machinery, at a cost of $35,000.

ST. JAMES, MINN.—The contract was let by the City Council for an electric light plant to the Fort Wayne Electric Corporation, of Fort Wayne, Ind., for the sum of $5,842.

WEEDSPORT, N. Y.—The Board of Trustees of Weedsport has granted a franchise to an electric light company, which agrees to furnish 35 arc lights for $1,500 per year.

MILWAUKEE, WIS.—The Council Committee on Electric Lighting decided to recommend that the city get authority from the State Legislature this winter to make and sell electric light.

READING, PA.—The special committee appointed some time ago to report upon the advisability of the city building its own electric light plant will urge the city to erect its own plant.

LEADVILLE, COL.—The Leadville (Col.) Water & Power Company is to build a pipe line 12 miles in length, and will erect a plant for the purpose of generating electricity to furnish power to the mines and smelters.

LYNCHBURG, VA.—The Lynchburg Electric Company has been awarded the contract for lighting that city with electricity for five years, and is also granted a franchise for poles and wires in the city streets for 30 years.

EDGEWATER, S. I., N. Y.—Application has been made by Cornelius G. Kollf, on behalf of the Midland Railway, for permission to change its motive power from horses to electricity, and to extend its lines to Richmond.

RALEIGH, N. C.—The Raleigh Electric Company's stockholders have authorized an issue of $25,000 of first mortgage bonds for the installation of its electric light plant, and to improve and enlarge its railway equipment.

PORTSMOUTH, N. H.—The Board of Aldermen is considering the purchase of an electric light plant of its own for $60,000, that can be maintained for $8,000 per annum and keep forty more arc lights going than at present.

BRIDGEPORT, CONN.—McMahon & Wren propose furnishing Pleasure Beach with a new and more powerful electric lighting plant, and are considering the wisdom of using the extra power for the operation of a trolley system.

ASBURY PARK, N. J.—The Neptune Eectric Company is in the hands of Judge Joseph H. Gaskill as receiver. The liabilities are $67,000; of the capital stock of $200,000, $54,000 had been paid in. Most of the loss will fall upon residents of Asbury Park.

MONTPELIER, IND.—A company known as the Montpelier Electric Light Company has been incorporated, and a lighting system will be introduced at that place. The capital stock of the company is $15,000. John P. McGeath, of Hartford City, and others, are interested.

SPRINGVILLE, N. Y.—The Western Electric Company, of Thames and Greenwich streets, New York City, was the lowest bidder for putting in the electric lighting plant at Springville, the bid being $9,580.80, and received the contract. The work is to be completed in six months.

ASHLAND, WIS.—The Citizens' Electric Light & Power Company, of Ashland, which has just been organized, will have its new plant in operation by Jan. 1. It has ample capital behind it, the stockholders and directors, include some of the best known and wealthiest men of the city.

BRANFORD, CONN.—The Branford Water, Light & Power Company has formally organized and elected the following officers: President, B. W. Allderige; secretary, E. F. Bennett; treasurer, F. W. Giddings. It is the purpose of the company to supply the town with water and electric lights.

SEATTLE, WASH.—The contract for lighting Seattle has been awarded to the Rainer Power & Railway Company & the Seattle Gas & Electric Light Company. The city is to be lighted by these new companies after Dec. 1, when the contract with the Union Electric Company expires.

ELIZABETHTOWN, PA.—A charter was granted some time ago to the Elizabethtown Electric Light Company, and the borough has lately given the company the contract to light its streets. The company has begun work on the erection of buildings. Mr. Alfred R. Houch, of this city, has been elected treasurer.

BLOOMFIELD, N. J.—At a meeting of the Bloomfield Township Committee, a long discussion took place over a suggestion by the Gas Committee that they be authorized to advertise for bids for electric lighting by arc lights of 2,000-cp, in view of the termination of the gas lighting contract. The matter was finally laid over until the next meeting.

ROME, N. Y.—The time for receiving bids for the construction of a boiler house and dynamo room at the Rome State Custodial Asylum has expired. No bids were received. The Trustees have found that the specifications lacked some details, and contractors were informed that bids would be readvertised for when these details were arranged.

OGDENSBURG, N. Y.—The Common Council held a special meeting at which the Mayor offered a resolution requesting the Committee on Fires and Lights to confer with the officers of the Ogdensburg Gas Company, and see if some arrangement can be entered into whereby the streets of that city may be lighted by electricity. A franchise was granted to the new electric street railway.

APPLETON, WIS.—A company has been formed by local capitalists to establish a competing electric light and power company, and bid for a share of the business now controlled by the Edison Company. Contracts have been let for a power-house, poles and wires, etc., and the company expects to furnish light by January 1. The plant will be constructed on a basis of 1,000 lights, and will cost about $40,000.

PITTSBURG, PA.—Next month a charter will be applied for by the Suburban Light, Heat and Power Company, which proposes to supply Mt. Oliver, Knoxville and other hill boroughs with electric energy. Those principally interested are Register S. P. Conner, Attorneys T. A. Noble, E. F. Hayes and James W. Patterson and others. A new power house will be built. The Suburban Electric Railway Company will have a controlling interest.

SYRACUSE, N. Y.—In amended form the Citizens' Electric Company's proposed franchise was submitted to the Council, and without action was referred to the Corporation Council and the Committee of the Whole. The amendments are as follows: The corporation shall proceed without delay to erect a plant of 10,000-light capacity, and increase the same from time to time as business may require. In case of default the franchise may be declared void.

PITTSBURG, PA.—Mr. W. R. Thompson, for several years in charge of the electrical plant of Joseph Horne & Co., in this city, has recently been appointed to take charge of the electric plant now being erected in the Carnegie building. This building is fourteen stories high, and is the largest in Western Pennsylvania. The electric plant, consisting of about 3,000 incandescent lights, is the most important isolated plant in this part of the country. All the apparatus is of Westinghouse manufacture.

CONEWAGO, PA.—The Conewago Water & Power Company has made a propositon to operate the water power of the Susquehanna River at or near Falmouth, at or near Chickies, at or near Wrightsville and below Wrightsville and at such points as may be deemed advisable by the company. The aggregate water power is about 10,000 horse power, which will be utilized for the purpose of generating electricity and transmitting it over the wires of the company to distances within a radius of 35 miles.

THE ELECTRIC RAILWAY.

McKEESPORT, PA.—The contract for an electric road between McKeesport and Glenwood has been let.

NEW ORLEANS, LA.—The New Orleans Traction Company will build an electric power plant.

LANCASTER, PA.—There is considerable talk of an electric railway from Lancaster to Elizabethtown.

POTTSVILLE, PA.—The Schuylkill Electric Railway Company will erect a $100,000 power-house at Pottsville.

CATESVILLE, PA.—A trolley line passing through the main street from one end of the borough to the other, is being discussed.

APPLETON, WIS.—The Appleton Edison Company will build and operate an interurban electric road from Kaukauna to Neenah.

CHICAGO, ILL.—The North Side Electric Street Railway Company has increased its capital stock from $500,000 to $1,500,000.

PINE BUSH, N. Y.—An effort will be made by some business men to have the electric road extended from Walden to this place.

SPRINGFIELD, O.—Manager S. L. Nelson reports a proposed expenditure of $75,000 in improvement and extension of street railway lines.

LOCKHAVEN, PA.—Residents of Nippenose Valley held a meeting to discuss the possibilities of an electric road between Lock Haven and Milton.

WILKESBARRE, PA.—The Wilkesbarre & East Side Railway Company has been granted an extension of eight months time for the construction of its railway.

PEEKSKILL, N. Y.—The Trustees of Peekskill on Tuesday night granted a franchise to the Beach Railway Company to build a trolley road through the village.

OGONTZ, PA.—The power station for the Jenkintown Road will be located at Ogontz. It will have a capacity of 2,500-h p, and space for additional engines and machinery.

WATKINS, N. Y.—The matter of constructing an electric railway between Watkins and Hanana is being seriously agitated. The road will be about three miles long.

CEDARTOWN, GA.—A franchise has been granted to Charles and J. W. Adamson, E. M. Wistar, J. A. Peck and others to build a street railway, using electric or other power.

NIAGARA FALLS, ONT.—The Town Council has decided to have nothing to do with the Toronto syndicate which proposes to build an electric line from Niagara, Ont., to Chippewa.

TRENTON, N. J.—The Trenton Common Council has passed a resolution to revoke the franchise of the Trenton Passenger Railroad Company. The company failed to provide for transfers.

CHICAGO, ILL. The Chicago Street Railroad Company is building a power-house at Hawthorne avenue and Hobble street. It is to cost $350,000, and Victor Falkenau & Bro. are the contractors.

BATAVIA, N. Y.—An application has been made to the Board of Trustees by A. B. Wilhus, in behalf of himself and the Batavia Street Railway Company, to construct and operate street railways.

WASHINGTON, D. C.—The Washington, Arlington & Falls Church Electric Company is securing right of way for its proposed line which is to extend between the points indicated in its title.

CAMBRIDGE, MASS.—Authority was given the West End Street Railway Company by the Cambridge Aldermen, at a meeting last week, to establish an electric system on Broadway in that city.

PITTSBURG, PA.—The Allegheny Traction Company's barns, on Spring Garden avenue, were destroyed by fire; also several cars and seven new electric motors. Loss, $75,000; insurance not known.

BUFFALO, N. Y.—A dispatch from Albany announces that the Crosstown Street Railroad Company, of Buffalo, has filed with the Secretary of State a certificate of the proposed extension of its route.

KINGWOOD, W. VA.—An effort is being made in Kingwood to raise money for the purpose of building an electric railway between that place and Morgantown and to continue the road to Uniontown, Pa.

NEWINGTON, CONN.—It is now practically decided that the road to be built by the Central Electric Company through this place, connecting New Britain and Hartford, will be completed next summer.

GREEN BAY, WIS.—Green Bay capitalists are considering the feasibility of an electric railroad between that city and Depere. Some of the merchants oppose the project on the ground that it will take away their trade.

GREENVILLE, N. Y.—The Common Council will consider the petition for a franchise presented by the Jersey City, Hoboken & Rutherford Electric Railway Company to operate a trolley system along the Paterson plank road.

FALL RIVER, MASS.—The articles of incorporation for a new electric road, of which the directors are Wendell E. Turner, Arnold B. Sanford, Albert S. Dow, and Mr. Shove is treasurer, will operate about three miles of track.

PUYALLUP, WASH.—An ordinance has been introduced into the City Council looking toward the granting of the right to construct, maintain and operate a street railway, to be completed by January 1, 1896, by W. H. Coler & Co.

APPLETON, WIS.—The Appleton-Edison Electric Light Company is said to have decided to build and operate an interurban railroad from Appleton to Kaukauna. The company's officers believe that the Tilotson project is practically dead.

CHESTER, PA.—The directors of the Nedia, Middletown, Aston & Chester Electric Railway Company will shortly hold a meeting, and it is stated on good authority that the new road will be built and in operation before many months.

MIDDLETOWN, N. Y.—The Middletown-Goshen Traction Company has practically decided to extend its line down the Walkill Valley to Montgomery, with the expectation of going to Walden later on. Montgomery is only twelve miles from Middletown.

ALLENTOWN, PA.—A party of New York and Philadelphia capitalists are trying to obtain franchises for the construction of an electric road from Allentown to Reading and the Town Council of Emanus has been asked for permission to occupy the streets.

ELYRIA, O.—A company has been formed here to construct an electric railway between this city and Oberlin. The capital stock is to be $100,000, and the road will be built next spring. The projectors are Hon. William A. Braman, C. A. Metcalf, Parks Foster and others.

LIMA, O.—Lima will have another street railway before long. The Lima College people, with some prominent citizen stockholders, have decided to build their own line which will run to the college and around the city; they were granted permission and will start at once.

MILTON, N. Y.—The Boston Electrical Construction Company, to whom the franchise for the construction of an electric railroad from Milton to Ballston Spa was granted, will begin work at once, so that the road will be running by August 1, 1895. The cost will be about $150,000.

FALL RIVER, MASS.—At a special meeting of the Board of Aldermen, November 29, on a petition of the Fall River & Taunton Street Railway Company for a franchise to operate an electric road on specified streets of this city, a hearing was granted to be held Friday, December 14.

HAMILTON, ONT.—The Hamilton Radial Railway Company has evolved a scheme to build a network of railroads, steam and electric, radiating from Hamilton and connecting with the more important cities and towns of Western Ontario, the main object being to divert trade to Hamilton.

LYKENS, PA.—The Council of Lykens has granted the new electric railway company, which will operate a line between Reiner City and Lykens, the right to occupy the streets of that town with its tracks. At Tower City the Williams Valley Railroad Company is opposing the granting of any privileges to its electric rival. The new line will probably be extended to Millersburg.

WALDEN, N. Y.—The company which proposes to build an electric railroad from Orange Lake to Walden has secured the consent of more than half the property along the proposed line, in the village of Walden as well as in the country. It is probable that part of the work of construction will be done this winter.

MARLBORO, MASS.—The Marlboro and Westboro Street Railway Company asked of the Aldermen for a franchise to lay tracks through Northboro and Main streets, from the town line to the soldier's monument. Lewis R. Wilkins,

engineer, represents the company, of which Dr. E. B. Harvey, of Westboro, is President. The road is to be six miles long.

GETTYSBURG, PA.—For the purpose of extending the Gettysburg Electric road to the Maryland line. Hon. Eph. Myers and Mr. John A. Shorb, of Littletown, were at Gettysburg endeavoring to get subscriptions for stocks and bonds. It is proposed to sell $50,000 of the $200,000 in bonds now existing on the road, so as to raise the cash necessary for building purposes.

BIRMINGHAM, ALA.—The Highland avenue & Belt Railway has been sold by Mr. H. M. Caldwell to the Columbus Equipment Company, of New York City. The purchaser will equip the road electrically, and has also secured an option on the East Birmingham Dummy Line, which, in the event of a sale being effected, would be converted to electric power.

GREENBUSH (P. O. ALBANY), N. Y.—A meeting of capitalists and representative citizens was held in Greenbush Friday evening, to discuss the proposed Albany & Suburban Railway Company. It is stated that steps will be taken soon to incorporate the company. It is probable that the trolley system will be abandoned and that the underground conduit will be used.

ISLIP, N. Y.—A syndicate composed of prominent New York and Brooklyn men who are interested in the Austral Hotel Company and Electrical Construction Company, are endeavoring to secure a franchise from the Islip Town Board for permission to run a trolley line from Brentwood, a winter resort among the pines, to the south side of the island, and thence to Babylon.

WARREN, O.—A. A. Anderson and John McVey, of Youngstown, made application to the Commissioners of this county for a franchise providing for the construction of an electric railway from Youngstown to Niles, ten miles. They agree, if a franchise is given them, to have it in operation within a year. Cleveland, Warren and Niles capitalists are also interested in the project.

POTTSVILLE, PA.—At a special meeting of Mt. Carbon Borough Council. The question of granting right-of-way to an electric railway through the streets of the borough was taken up, when, on motion of Patrick Malone, seconded by Patrick Graney, the Pottsville & Reading Traction Company was granted a trolley franchise This will be a branch of the Schuylkill Electric Railway.

WEYMOUTH, MASS —The Quincy & Boston Electric Railway has petitioned the Weymouth Selectmen for a location from Commercial Square, East Weymouth, to Columbian Square, South Weymouth, through Pleasant street. The building of this extension will give continuous electric service from Boston to Brockton, through Quincy, Weymouth, Rockland, Abington and Whitman.

THE NEWTOWN RAILWAY COMPANY has obtained a franchise to operate an electric system in the town of Newtown, from the point bordering on Long Island City to the Flushing line. The company already has a franchise to operate in Long Island City to the Flushing line, so that an electric road from the latter place to Thirty-fourth Street Ferry now seems to be an assured fact.

WATERLOO, N. Y.—The Waterloo, Seneca Falls and Cayuga Lake Railway Company, which is to build and operate a surface road four miles from the village of Seneca Falls to Orchard Beach, on the shore of the Cayuga Lake, has been incorporated. Capital $150,000 Directors, Thos. Craig, of Trenton, N. J.: Chas. E. W. Smith, of New York; Chas. L. Hoskins, of Seneca Falls, and others.

BALTIMORE, MD.—The Baltimore, Middle River & Sparrow's Point Railway Company has about finished its electric road to Back River bridge, a distance of about four miles, and will build branch lines to Ivy Point and Fairy Grove. The company may later on extend its road to Middle Station, on the Philadelphia, Wilmington & Baltimore Railroad. Charles B. McClenn is the company's engineer.

MAPLEWOOD, N. J.—A meeting for the purpose of discussing the advisability of having a trolley road through Maplewood, was held at the residence of Edward L. Crowell. Mr. Crowell was chairman of the meeting, and Alexander Melville was secretary. Those present advocated the construction of a trolley road, and the sentiment as in favor of the Newark and South Orange Street Railway Company.

M'KEES ROCKS, PA.—The proposed scheme of an electric trolley boat system on Chartiers Creek, between McKees Rocks and Carnegie, was the subject of another meeting held at McKees Rocks. Dr. Barr was elected president, and W. H. Sprout secretary. Application for a charter and estimates of the probable cost of the work will be made. It is proposed to widen the creek to 150 feet between the two points.

TERRE HAUTE, IND.—The special election to vote on the subject of appropriating $20,000 to aid in the construction of the Terre Haute and Brazil Electric Railway Company cannot be held on Dec. 17 as was expected. The petitioners failed to file their bond in time to advertise the election four weeks as required by law. The County Commissioners will take up the matter again, and if the bond is satisfactory will fix another date for the election.

CLARKSBURG, W. VA.—The Clarksburg & Suburban Street Railway Company, whose incorporators are R. S Gardner, Lee H. Vance, Marck McD. Price, C. M. Hart and others, has been granted a franchise for twenty-five years by the Town Council of Clarksburg, to use and occupy certain streets of the city for the construction and operation of an electric street railway. It will be extended to a place on the Milford turnpike opposite the Chautauqua Assembly Ground.

NEW BRIGHTON, S. I., N. Y.—Another enterprise has been developed in the extension and electrical equipment of the lines of the Midland Railroad Company, running from West Brighton to Castleton Corners and from Stapleton to Concord. These lines are principally owned by Nathaniel Niles, of New Jersey, and Otto Ahlmann, president of the Bank of Staten Island. It is said this road has consolidated with the Prohibition Park Electric Railway Company.

COLUMBUS, GA.—The North Highlands Electric Railway Company and the Columbus Street Railway Company have been consolidated. Samuel A. Carter, president of the North Highland line, resigned, and Mr. John Flournoy, president of the Street Railway Company, was elected president of the North Highland line, which will maintain separate organization, but will be controlled by the Columbus Street Railway Company. The lines of both companies will be extended.

LIMA, O.—The proposed new electric street car line will be built without a doubt. The directors are: Col. W. P. Orr, of Piqua; Gen. A. V. Rice, of Columbus; Stewart M. Brice, George H. Meily and Judge J. E. Richie. The line will take in the new Lutheran College, and probably extend to McBeth's and Hover's Lakes, both summer resorts, and it may be extended so as to take in Spencerville and Delphos. The work of surveying the line will be commenced at once.

CLEVELAND, O.—A step toward the extension of the Pearl Street Car Lines across the Brooklyn bridge into the village of South Brooklyn was taken on November 14, when the Cleveland Electric Railway Company bought six acres of land lying between the Columbus pike and the State road. An officer of the railway said that his company expected to have cars running across the bridge early next spring, and that work would be begun toward building a large car-house and perhaps a power-house on the property purchased, as soon as practicable.

NEWARK, N. J.—The Freeholders' Committee on Roads and Assessments met and received two petitions from the North Jersey Street Railway Company for franchises for a surface railway from the village of Irvington, along Springfield avenue, through Clinton township and the townships of South Orange and Millburn, to the Essex County line. The other petition was for a similar franchise for a road beginning at Bloomfield, through the town of Montclair, Verona and Caldwell townships, and Caldwell borough. It was proposed to build double track roads and have them operated with electricity. Both petitions were held over until the next meeting of the committee.

Trade and Industrial Notes.

W. P. THOMPSON & COMPANY, 31 High Holburn, London, England, have reorganized their business and added largely to the technical staff. They have also issued a new edition of their "Chart of Requirements for European Patents."

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, O., has just received a duplicate order for its machines from Sioux Falls, S. D., and a triplicate order from Dallas, Tex. The company reports November business as very encouraging, and has just placed an order in the foundry for 90,000 pounds of dynamo and motor castings.

M. H. DEVEY, 160 North Fourth street, Philadelphia, has perfected an electrical compound glass cement for use with underground systems to prevent moisture getting to the wires, and for lining pipes of all kinds inside or outside. This glass cement is also suitable for power house floors and roofings. Being a good non-conductor, it is useful for repairs and for stopping leaky roofs of all kinds. It is a strong resistant to water and is particularly adapted for bedding electrical machinery in power houses, etc. It is applied as a paint, or used as a plaster, and is also adapted for general building purposes, as it may be applied to iron, wood, stone or brick.

THE OHIO BRASS COMPANY, Mansfield, Ohio, reports a large number of initial orders for the reversible and adjustable track brush holders, and steel wire track brooms, which have been followed in almost every case by larger ones. In many instances the entire equipment of motor cars have been provided with these. Among the larger roads using them are: The Syracuse Street Railway, Syracuse, N. Y.; The Middletown-Goshen Traction Company, Middletown, N. Y., The Cumberland Electric Railway, Cumberland, Md., The Burlington Electric Railway, Burlington, Iowa, The Steinway Railway Company, Long Island City, N. Y., The Central Electric Railway, Peoria, Ill. The ease with which these holders can be manipulated, and the saving in consequence in the wear on the track brooms, is a strong recommendation in their favor.

THE VIADUCT MANUFACTURING COMPANY, Baltimore, Md., of which Mr. A. G. Davis is president, has established a new factory in the city of Baltimore, pending the reconstruction of its extensive plant at the Relay Station, on the B. & O. R. R., between Baltimore and Washington, which was destroyed by fire in June last. The power waterhouse has already been rebuilt and the other buildings will be completed next spring. In the meantime, orders will be promptly filled from the city works. This company has been making the well-known viaduct magnetic telephone bells without intermission since 1878. So long an experience should have given it an opportunity to perfect the article—and it seems to have done so. Large numbers of district messenger call boxes are also daily turned out by it, one company alone having used 35,000. It is constantly devising new forms and patterns of call boxes and is now filling a large order from St. Louis and Kansas City for the Missouri District Messenger Company.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., has just closed a contract with the Overman Wheel Company, for an electric power transmission plant for its works at Chicopee Falls, Mass., consisting of one 100-kw new type multipolar generator, two 25, one 20 and two 10-hp Manchester motors, with complete switchboard. The Mather Company, which is making a specialty of this class of work, is also installing a similar plant with a 60-kw generator, in the mill of the Connecticut River Paper Company, at Holyoke, Mass. The same company also booked last week the following orders: one 60-kw new type multipolar generator for the Pierpont Manufacturing Company, New Bedford (3rd order); one 550-light dynamo for the receivers of the Union Pacific R. R., Pocatello, Idaho; one 550-light dnyamo for the Rockwell Mfg. Company, Milwaukee, Wis.; one 550-light dynamo for the Hub Gore Makers, Brockton, Mass.; one 100-kw railway generator for the Ithaca Street Railway Company in Ithaca, N. Y.; one 15-kw direct connected dynamo, with Ideal engine, for the Wayne Hotel, Detroit, Mich.; one 350-light dynamo (ring tpye) for the Meriden Britannia Company, Meriden, Conn.; one 350-light dynamo for the Berlin Iron Bridge Company, East Berlin, Conn.; one 150-light dynamo for Burtis & Howard, Minneapolis, Minn.; one 250-light dynamo for C. Dorflinger, White Mills, Pa.; one 150-light dynamo for H. B. Coho & Company, New York City; fifteen Manchester motors from 3 to 15-hp.

Business Notices

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

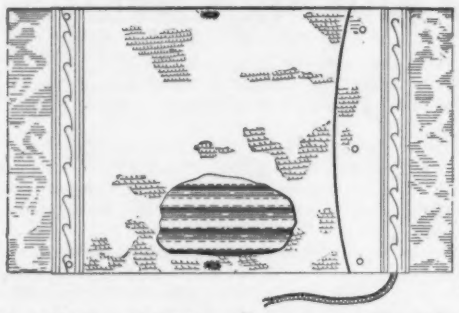
UNITED STATES PATENTS ISSUED NOVEMBER 27, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

529,688. MEANS FOR SUPPORTING MOTORS IN ELECTRIC LOCOMOTIVES; W. S. Adams, Philadelphia, Pa. Application filed November 9, 1893. The combination, in a truck, of side bars, cross bars, longitudinal bars, suspended below the side bars, and means for adjustably suspending the longitudinal bars to the cross bars.

529,704. CLOSED CONDUIT ELECTRIC RAILWAY; C. G. Burke, Brooklyn, N. Y. Application filed February 10, 1894. This comprises a contact arm, two trolleys carried thereby, a supply conductor, a series of normally open branch conductors, means for closing the branches successively, adapted to be operated by one of the trolleys, a return conductor, and circuit connections between the car motor and trolley.

529,710. SECTIONAL THERMO ELECTRIC GENERATOR. H. B. Cox, Hartford,



No. 530,053.—Electric Towel for Heating.

Conn. Application filed January 31, 1894. A generator built up of interchangeable sections, each section exteriorly coated and complete within itself.

529,711. THERMO ELECTRIC GENERATOR; H. B. Cox, Hartford, Conn. Application filed January 31, 1894. A generator having an exterior cooling jacket and an interior liquid body and means for heating the body of liquid.

529,759. ELECTRIC SIGNAL FOR RAILWAY CROSSINGS; D. W. Smith, St. Louis, Mo. Application filed September 10, 1894. This comprises a crossing clamp, a supply conductor, an electric lamp mounted upon and supported by the clamp, and a supply conductor for the lamp.

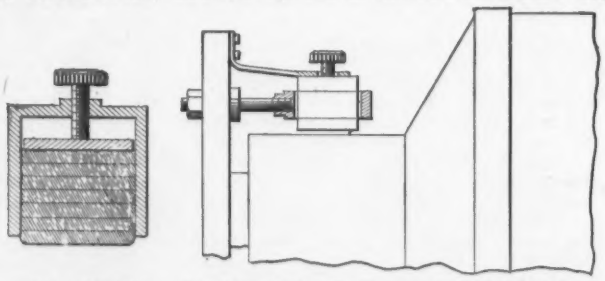
529,784. COMMUTATOR BRUSH FOR DYNAMOS; G. Forbes, London, Eng. Application filed August 8, 1892. A brush consisting of conducting fibrous or textile material.

529,797. CLOSED CONDUIT FOR ELECTRIC RAILWAYS; F.L. King, Chicago, Ill. Application filed January 15, 1894. This comprises a support having journals and a cover removably pivoted to the journals.

529,811. RAILROAD SIGNAL; C. Selden and F. P. J. Pateuall, Baltimore, Md. Application filed December 18, 1893. The combination of a main signal, its actuating disk, an overbalancing weight connected with the track lever, a "dwarf" signal, and a power winding ratchet upon the disk for the dwarf signal.

529,812. RAILROAD SIGNAL; C. Selden, Baltimore, Md. Application filed January 4, 1894. The combination of a signal magnet requiring momentary action, a relay, a circuit closer and breaker in the circuit thereof, a circuit controller for the signal magnet, and means for producing a double change of position in the controller on movement of the relay armature in one direction only.

529,818. TELEPHONE; A. Stromberg and A. Carlson, Chicago, Ill. Applica-



No. 529,784.—Commutator Brush for Dynamos.

tion filed October 9, 1894. This comprises a casing inclosing the coils, a diaphragm support mounted thereon, a permanent magnet, and a casing enclosing the magnet removably secured to the rear of the first named casing.

529,826. TELEPHONE SWITCH; E S. Combs, Rochester, N. Y. Application filed October 9, 1894. This comprises a plate, arms and lever, contacts, a leaf spring, and a link connected at its ends to the spring and the lever.

529,836. CONDUIT ELECTRIC RAILWAY; L. C. Pressley, San Francisco, Cal. Applicatin filled February 6, 1894. This comprises a sectional trolley rail, a conducting wire, and means whereby the sections of trolley rail are charged successively from the wire while the car is passing and cut off afterwards.

529,866. ORNAMENT FOR LIGHTNING RODS; C. F. Keys, Washington, D. C. Application filed March 22, 1894. This comprises a rod and an index formed of two crossed integral arms bent to form the central sockets and terminals in spindle ends, for the reception of letters.

529,894. SIGNALLING APPARATUS FOR TELEPHONE EXCHANGE SYSTEMS; J. H. Cary, Malden, Mass. Application filed March 17, 1894. The combination of a transmitter battery, a local circuit connected therewith, a call bell in the circuit, and a relay controlling the local circuit and connected with the line.

529,895. KEYBOARD ATTACHMENT FOR MUSICAL INSTRUMENTS; J. D. Case, Plainfield, N. J Application filed March 30, 1893. This comprises a revolving armature and electro-magnet coating therewith, and adapted to operate a sound producing device.

529,903. TROLLEY WIRE SUPPORT AND COUPLING; A. P. Gould, Canton, Ohio. Application filed March 7, 1894. This comprises a body portion having at its lower edge a ledge, a cap having elongated apertures, and binding screws.

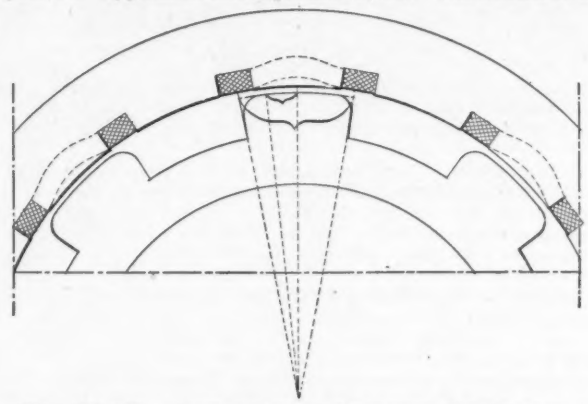
529,918. ALTERNATING CURRENT GENERATOR; J. F. Kelly, Pittsfield, Mass. Application filed August 18, 1894. This comprises a field magnet and armature having opposing faces, one of which bears to the other the relation expressed by the formula of an inverse sinusoidal curve.

529,975. SPEED INDICATOR AND ALARM; G. A. Thompson and J. F. Schmadeke, Brooklyn, N. Y. Application filed April 27, 1894. Two contact rods forming terminals of an electric circuit, a supporting post for the circuit closing rod, a weight carried by the rod, an insulated block in stationary bearings and revolving with the rod, pivoted arms connecting the block and weight, and weight balls carried by the arms.

529,984. ELECTRIC SIGNAL APPARATUS; H. E. Walter, Richfield Springs, N. Y. Application filed January 9, 1893. This comprises a dial, an indicator moving on the dial, an escapement for automatically operating the indicator, a magnet for operating the escapement, and a spring for automatically assisting the movement of the indicator in one direction.

529,986. ELECTRIC SIGNALLING APPARATUS; H. E. Walter, Richfield Springs, N. Y. Application filed April 26, 1894. This comprises signal boxes, connections to a central station, a box selecting device at the central station, a retransmitting apparatus, a circuit operated by the retransmitting apparatus, and indicating apparatus operated by the circuit.

529,992. CONDUCTOR COIL FOR ARMATURES AND FIELD MAGNETS AND METHOD OF MAKING SAME; E. W. Alexander and H. Groswith, Philadelphia, Pa. Application filed September 22, 1893. This consists in winding



No. 529,918.—Alternating Current Generator.

a conductor with a spacing cord and thereafter removing the cord and covering the winding with enamel.

529,999. SWITCHBOARD; L. A. Berthon, Paris, France. Application filed October 17, 1893. This comprises movable spring jacks having springs, in combination with connecting springs making frictional contact with the former springs, and an insulating piece between the springs.

530,004. ELECTRICAL CONTACT MECHANISM; J. F. Blake, New Haven, Conn. Application filed June 21, 1894. This comprises an arm, a rotatable disk, and contacts placed within reach of the disk.

530,020. APPARATUS FOR WELDING RINGS; C. L. Coffin, Detroit, Mich. Application filed March 13, 1894. This comprises a clamp, a movable furnace, a movable anvil, and connecting mechanism for moving the furnace toward the clamp, and moving the anvil in proper relation to the clamped article.

530,021. METHOD OF ELECTRICALLY HEATING METAL; C. L. Coffin, Detroit, Mich. Application filed July 10, 1894. This consists in bringing the metal in circuit with a liquid electrode containing a substance more volatile than water.

530,032. ELECTRIC ELEVATOR MOTOR; W. C. Fletcher, St. Louis, Mo. Application filed June 14, 1894. This comprises an armature wound in independent multiple and a sectional series field to produce a counter electromotive force which will equal that of the normal speed when first starting the motor, and means for constantly maintaining the counter electro-motive force.

530,033. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; Z. Foster, Chicago, Ill. Application filed March 7, 1894. This comprises a line wire and branches, a sectional conductor arranged opposite the terminals of the branches, contact blocks, springs for normally separating the sections and branches, and a trolley mechanism for producing the required engagement.

530,053. ELECTRIC ROBE FOR HEATING; H. G. O'Neill, Boston, Mass. Application filed April 9, 1894. This comprises a resistance and flexible fabric, and a branch conductor for cutting out the resistance.

530,066. PLUG AND RECEPTACLE FOR ELECTRICAL PURPOSES; D. J. Cartwright, Boston, Mass. Application filed January 24, 1894. A plug having a tapered body, electrodes, a socket for the reception of the body of the plug, and electrodes secured to the block.